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REVISION OF THE FLEA GENUS
PEROMYSCOPSYLLA

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Fleas of the genus *Peromyscopsylla* I. Fox, 1939 (family Ceratophyllidae, subfamily Leptopsyllinae), are characteristic parasites of murid and cricetid rodents and are distributed throughout much of Europe, Asia, and North America. For these reasons they are of potential medical importance. Although 20 forms of *Peromyscopsylla* have been considered valid up to the present time, on the whole this group of fleas has been poorly known and inadequately figured. A revision of the genus is necessary for the following reasons: (1) Considerable confusion exists as to the identity and status of the various forms; (2) the range of certain species is far greater than is generally appreciated; and (3) as originally defined the genus was limited to North America.

The present paper redescribes and illustrates the known forms, two names are considered synonyms and two other nomenclatorial changes are made, and the heretofore unknown female of *P. draco* Hopkins, 1951, the male of *P. ostsibirica longiloba* (Jordan, 1939), new status, and a new subspecies of *P. hamifer* are described. The aedeagus of this genus is of a distinctive type, and, as indicated in a subsequent section of this paper, a comparative study of its morphology sheds light on the affinities of the various species.

The authors wish to express their deep appreciation to the following specialists who generously allowed the study of their collections: E. W. Jameson, Jr., University of California; Frank A. Prince, W. L. Jellison, H. B. Morlan, and H. D. Pratt of the U. S. Public Health Service; G. P. Holland, Canada Department of Agriculture; G. A. Augustson of the Madera County (California) Mosquito Abatement District; C. F. Muesebeck, U. S. Department of Agriculture;

R. B. Eads, Texas State Board of Health; V. J. Tipton, Army Medical Service Graduate School; and G. H. E. Hopkins and F. G. A. M. Smit, British Museum.

To a great extent this paper is based upon material in the U. S. National Museum, to which we were allowed access. That museum is serving as depository for the types of the new form described herein and for specimens of the previously unknown female of *Peromyscopsylla draco*.

We are also deeply indebted to Dr. Karl Jordan, F.R.S., for his generous help in the early stages of this study, and to G. H. E. Hopkins and the Honorable Miriam Rothschild for allowing us to quote synonymy from their excellent manuscript on fleas in the N. C. Rothschild Collection.

Thomas Evans, Department of Entomology, Army Medical Service Graduate School, kindly drew copies of Skalon's *Peromyscopsylla ostsibirica* figures for inclusion in this paper.

Genus PEROMYSCOPSYLLA I. Fox, 1939

Peromyscopsylla I. Fox, Proc. Ent. Soc. Washington, vol. 41, p. 47, 1939; Fleas of the eastern United States, pp. 8, 78, 84, 1940.—JELLISON and GOOD, U. S. Public Health Service, Nat. Inst. Health Bull. 178, p. 121, 1942.—EWING and FOX, U. S. Dept. Agr. Misc. Publ. No. 500, p. 90, 1943.—HUBBARD, Fleas of western North America, pp. 274, 328, 1947.—HOLLAND, Canada Dept. Agr. Techn. Bull. No. 70, pp. 54, 175, 1949.—HOPKINS, Ann. Mag. Nat. Hist., ser. 12, vol. 4, pp. 540, 541, 1951.

Head.—Fracticipate. Bullet-shaped, preantennal region with strongly rounded anterior and dorsal margins, more than twice as high as broad at level of distinct but reduced frontal tubercle. Anterior margin with a row of bristles of which two to four are usually spiniform. Preantennal region with five or six nonmarginal bristles and two or three shorter ones near dorsal margin. Eye reduced. Anterior tentorial arm (fig. 1, *A.T.A.*) visible anterior to eye. Labial palpus 5-segmented, about one-half length of forecoxa. Genal ctenidium of two distinct horizontal, posteriorly directed spines, one above the other; heavily pigmented genal process (fig. 1, *G.P.*) above genal spines, but at times hidden by more dorsal spine. With a genal lobe (figs. 1, 74, *G.L.*) of varying length ventral to spines of ctenidium. Postantennal area with three to five rows of bristles; with one rather stout bristle near posteroventral angle of antennal groove. No tuber present on upper margin of antennal groove.

Thorax.—Procoxa articulated at anterodorsal angle of prosternum. Pronotal ctenidium of 24 to 30 long dark spines. Lateral metanotal area about $1\frac{1}{2}$ times as long as high. Pleural arch well defined.

Legs.—All tibiae with dorsomarginal comb of short, stout, black bristles (fig. 2). Femora with dorsomarginal row of small, evenly spaced, very short, sharply pointed bristles, giving a serrate appearance. Fifth segment of each tarsus with four lateral plantar bristles and basal submedian pair.

Abdomen.—Unmodified abdominal terga typically with two rows of bristles; in some cases anterior row represented by one bristle or entirely absent on some specimens. Terga one to six with apical spinelets.

Male.—Eighth sternum usually associated with a mesal membranous nonapical process of varying length (fig. 78, *M.P.*). Manubrium long and acuminate. Digitoid or movable finger of clasper with three or four long, rather heavy marginal bristles.

Aedeagus.—Aedeagal apodeme (figs. 7, 94, *AE.A.*) about four to seven times as long as broad and about three to five times as long as portion distad of apodemal strut. Median dorsal lobe (fig. 104, *M.D.L.*) typically weakly sclerotized. With a distinctive and generally conspicuous movable pair of subdorsal lobes, herein designated as distolateral lobes (*DL.L.*), lying apical and lateral to sclerotized inner tube (*S.I.T.*). Distolateral lobes articulated with *S.I.T.* by means of a sclerite we are terming the fulcrum (*FM.*); also connected with the fairly well-developed lateral lobes (*L.L.*). In certain species the distolateral lobes bear a heavily sclerotized median area which is at times circular in appearance, the central thickening (*C.TH.*). Sclerotized inner tube (*S.I.T.*) short, oblique in undisturbed position, with armature (*A.I.T.*) usually limited to a short dorsal spur; its apex (*A.S.I.*) at times with a short dorsal expansion; its lateral sclerotization (*L.S.I.*) usually unspecialized, although at times produced into a definite keel (fig. 117). Band of inner tube (*B.I.T.*) usually apparent. Crochets (*CR.*) typically represented at least by a long daggerlike or sagittate sclerotized projection; at times well developed and suggesting *Leptopsylla* Jordan and Rothschild, 1911 (fig. 121). Penis rods (fig. 7, *P.R.*) uncoiled. Proximal spur (fig. 115, *P.S.*) usually absent. Apical appendage very short (fig. 7, *AP.A.*). Vesicle (*V.*) at best only indicated. Dorsal (*D.I.R.*) and ventral (*I.R.*) intramural rods usually fairly well sclerotized. Extensions of lateral plate of apodeme (*AL.L.*) variable, at times quite broad. Apodemal strut consisting of the usual sclerites: a relatively long subovate lateroventral sclerite (*L.S.*), a median irregular sclerite (*M.S.*), and a dorsal somewhat convex one (*D.S.*). Crescent sclerite (*C.S.*) long, conspicuous.

Female.—Bursa copulatrix (fig. 9, *B.C.*) well sclerotized, sinuate and narrow, with expanded bulblike apex at point of juncture with spermathecal duct (*SP.D.*). Body of spermatheca ovate to subovate, tail usually joining head with no definite line of demarcation. Eighth tergum with patch of extremely small mesal hairs proximal to ventral anal lobe. Eighth sternum reduced, poorly sclerotized and with no bristles. Ninth sternum much reduced, with no bristles or hairs.

Genotype.—*Ctenopsyllus hesperomys* Baker, 1904.

Remarks.—*Peromyscopsylla* can be separated from *Leptopsylla* (*sensu stricto*) by the fact that the genal comb consists of two horizontal subparallel spines, not three, four, or six spines; and by the absence of a distinct *trabecula centralis*. Dr. Karl Jordan (*in litt.*) has pointed out an additional fundamental feature: in *Peromyscopsylla*, the base of the forecoxa extends upward and covers the anterior end of the prosternum. In *Leptopsylla* (*sensu stricto*) the anterior end of the prosternum is above the base of the coxa (Smit, 1951), while the *trabecula centralis* is prominent as a dark tuber at upper margin of antennal groove.

Peromyscopsylla and *Paractenopsyllus* Wagner, 1938, are the only genera in the subfamily Leptopsyllinae that possess a genal comb of two spines. In the latter genus, however, the spines of the comb are vertical in position, not horizontal, and the spines are pointed, not blunt. *Paractenopsyllus* nevertheless agrees with *Peromyscopsylla* in the absence of the *trabecula centralis*, and in the manner of attachment of the procoxa to the anterior end of the prosternum. There are genitalic differences beyond the scope of this paper.

The characters of the subfamily Leptopsyllinae have been discussed by Traub (1952), who lists reasons as to why this group of fleas belongs in the Ceratophyllidae and not the Hystriochopsyllidae. Affinities with the Amphipsyllinae are therein pointed out.

KEY TO MALES OF GENUS PEROMYSCOPSYLLA

1. No spiniforms at frontodorsal angle of head (fig. 91).....2
Two or more spiniforms at frontodorsal angle of head (fig. 1).....3
2. Second antennal segment with extremely short bristles (not reaching past second segment of club); crochets duckbill-shaped (fig. 115, *CR.*); well-developed proximal spur (fig. 115, *P.S.*); eighth sternum conical, bearing three apical and five or six subapical bristles (fig. 99).....*himalaica* (Rothschild), p. 62
Second antennal segment with apical bristles reaching end of club; crochets very large, slipper-shaped (fig. 121, *CR.*); no proximal spur; eighth sternum apically long and narrow, with ventromarginal row of bristles (fig. 97).....*tikhomirovae* (Ioff), p. 60

3. Genal process hidden by upper genal spine (fig. 74); three dorso-submarginal bristles between spiniforms and antennal groove (fig. 74) . . . 4
 Genal process visible above upper genal spine (fig. 1, *G.P.*); two dorsosubmarginal bristles between spiniforms and antennal groove (fig. 1) 9
4. Movable finger long, narrow, and crescentic (fig. 87, *F.*); lateral lobe of aedeagus (fig. 120, *L.L.*) with large, scalelike spicules
bidentata (Kolenati), p. 54
 Movable finger more or less triangular (figs. 81, 82, 86, *F.*); lateral lobe of aedeagus with small spicules (figs. 117-119, *L.L.*) 5
5. Crochets (fig. 119, *CR.*) as long as, or longer than, sclerotized inner tube (*S.I.T.*); eighth sternum (fig. 85) with long bristles submarginal 6
 Crochets (fig. 117, *CR.*) not as long as sclerotized inner tube (*S.I.T.*); eighth sternum with long bristles obviously lateral, removed from apex at least by length of the short apical bristles (fig. 76) 7
6. Eighth sternum with ventral margin straight (fig. 85)
ostsibirica longiloba (Jordan), p. 53
 Eighth sternum with ventral margin concave (fig. 122, 8*S.*)
ostsibirica ostsibirica (Skalon), p. 51
7. Eighth sternum (fig. 76) with only two long bristles; dorsal margin of movable finger (fig. 81, *F.*) markedly convex (North America, Rocky Mountain region) *hamifer vigens* (Jordan), p. 47
 Eighth sternum (fig. 78) with three or four long bristles; dorsal margin of movable finger (fig. 82, *F.*) straight or somewhat concave . . . 8
8. Four long bristles on eighth sternum (fig. 78); movable finger (fig. 82, *F.*) with posterior margin markedly concave
hamifer hamifer (Rothschild), p. 43
 Three long bristles on eighth sternum (fig. 129); movable finger (fig. 131, *F.*) with posterior margin straight
hamifer cuneata new subspecies, p. 49
9. Upper genal spine the longer (fig. 59) 10
 Upper genal spine the shorter (fig. 1) 14
10. Preantennal area of head with six long bristles (discounting marginals and subdorsals) (fig. 55); eighth sternum broad, bearing seven to nine long marginal bristles (fig. 53) . . . *selenis* (Rothschild), p. 31
 Preantennal area of head with five long bristles (discounting marginals and subdorsals) (fig. 1); eighth sternum with no more than two long submarginal bristles (figs. 61, 66, 69, 71) 11
11. Postantennal area of head with rows of bristles irregular (fig. 1); apex of eighth sternum rounded (fig. 61); distolateral lobe of aedeagus (fig. 112, *DL.L.*) very large, three-fourths length of end chamber; lateral lobe (*L.L.*) reduced *catatina* (Jordan), p. 34
 Postantennal area of head with four regular rows of bristles (fig. 74); apex of eighth sternum (fig. 66) truncate; distolateral lobe of aedeagus (fig. 113, *DL.L.*) small, one-third length of end chamber; lateral lobes (*L.L.*) normal, not reduced 12
12. Movable finger rather narrowly expanded dorsocaudally; without patch of small proximal bristles (fig. 64, *F.*); long bristles on

- ventral (posterior) margin of distal arm of ninth sternum (fig. 73) as long as distance between most-apical long bristle and apex of ninth sternum (Great Britain)..*silvatica spectabilis* (Rothschild), p. 39
- Movable finger not expanded dorsocaudally; with patch of small proximal bristles (figs. 65, 68, *F.*); long bristles on ventral (posterior) margin of distal arm of ninth sternum (figs. 70, 72) definitely shorter than distance between most-apical long bristle and apex of ninth sternum.....13
13. Movable finger (fig. 65, *F.*) more than two times as long as broad at widest point; apical half of eighth sternum (fig. 71) broadest apically (Europe and Asia).....*silvatica silvatica* (Meinert), p. 36
- Movable finger (fig. 68, *F.*) less than two times as long as broad at widest point; apical half of eighth sternum (fig. 69) broadest sub-apically (European Alps).....*silvatica fallax* (Rothschild), p. 41
14. Genal lobe less than one-half length of lower genal spine (fig. 43, *G.L.*); no erect bristles dorsally on mesonotum (fig. 23).....15
- Genal lobe more than one-half length of lower genal spine (fig. 1, *G.L.*); erect bristles dorsally on mesonotum (figs. 4, 21, 22).....17
15. Frontal angle of head sharp (fig. 43); movable finger (fig. 47, *F.*) almost as broad as long; apically, eighth sternum bearing three or four long and three or four shorter marginal and submarginal bristles (fig. 45).....*draco* Hopkins, p. 26
- Frontal angle of head more rounded (fig. 1); movable finger (figs. 41, 49, *F.*) almost two times as long as broad; apically, eighth sternum bearing no more than three bristles (figs. 39, 52).....16
16. Crochet extremely short, base only well-sclerotized portion (fig. 107, *CR.*); apex of eighth sternum (fig. 52) truncate, bearing three very long apical bristles; movable finger strongly produced dorsocaudally (fig. 49, *F.*).....*scotti* I. Fox, p. 27
- Crochet (fig. 110, *CR.*) longer than sclerotized inner tube (*S.I.T.*); apex of eighth sternum (fig. 39) narrowly rounded, bearing two medium-sized and one small bristle; movable finger (fig. 41, *F.*) not strongly produced dorsocaudally.....*ebrighti* (C. Fox), p. 24
17. Lower margin of immovable process of clasper (fig. 10, *P.*) less than one-half length of upper margin; movable finger (*F.*) more than two times as long as broad (eastern United States and Canada).....*hesperomys hesperomys* (Baker), p. 8
- Lower margin of immovable process of clasper (figs. 17, 19, 29, *P.*) more than one-half length of upper margin; movable finger (*F.*) not more than two times as long as broad.....18
18. Erect dorsal bristles on mesonotum very heavy and dense, especially anteriorly (fig. 21); anterior margin of head almost vertical (fig. 14) (northern Rocky Mountain area)
- hesperomys ravalliensis* (Dunn), p. 14
- Erect dorsal bristles fine and not dense (fig. 22); anterior margin of head definitely oblique (fig. 13).....19
19. Movable finger broadest at middle; about two times as long as broad (fig. 17, *F.*) (Pacific Northwest: Canada, United States)
- hesperomys pacifica* Holland, p. 19

Movable finger usually broadest above middle, definitely less than two times as long as broad (figs. 29-31, *F.*) (southwestern United States, Rocky Mountains, and east to Alberta, the Dakotas, Colorado, Texas).....*hesperomys adelpha* (Rothschild), p. 17

KEY TO FEMALES OF THE GENUS PEROMYSCOPSYLLA

1. No spiniforms at frontodorsal angle of head (fig. 91).....2
 Two or more spiniforms at frontodorsal angle of head (fig. 1).....3
2. Second antennal segment with extremely short bristles (not reaching past second segment of club); pedestal of antepygidial bristles divided, so that there is a gap between upper two bristles and ventralmost bristle (fig. 102).....*himalaica* (Rothschild), p. 62
 Second antennal segment with apical bristles reaching end of club; pedestal of antepygidial bristles not divided....*tikhomirovac* (Ioff), p. 60
3. Genal process hidden by upper genal spine; three dorsosubmarginal bristles between spiniforms and antennal groove (fig. 74).....4
 Genal process visible above upper genal spine (fig. 1, *G.P.*); two dorsosubmarginal bristles between spiniforms and antennal groove....6
4. No row of short bristles above spiracle on eighth tergum
bidentata (Kolenati), p. 54
 Row of five or six short bristles above spiracle on eighth tergum.....5
5. Posterior margin of seventh sternum with long narrow lobe at least one-half as long as bristles in row on the sternum (fig. 84)
 (Siberia).....*ostsibirica ostsibirica* (Skalon), p. 51
 (Alaska).....*ostsibirica longiloba* (Jordan), p. 53
 Posterior margin of seventh sternum with lobe subtriangular; its length no more than one-third that of bristles in row on the sternum (fig. 75)
 (North America, east of Rocky Mountains)
hamifer hamifer (Rothschild), p. 43
 (North America, Rocky Mountain region)
hamifer vigenis (Jordan), p. 47
 (Asia, Korea).....*hamifer cuneata*, new subspecies, p. 49
6. Upper genal spine the longer (fig. 59).....7
 Upper genal spine the shorter (fig. 1).....9
7. Preantennal area of head with six long bristles (discounting marginals and subdorsals) (fig. 55).....*selenis* (Rothschild), p. 31
 Preantennal region with five long bristles (discounting marginals and subdorsals) (fig. 1).....8
8. Apical bristles on second antennal segment extremely short, not reaching apex of second segment of club; rows of bristles on postantennal area of head irregular (fig. 1).....*catatina* (Jordan), p. 34
 Bristles on second antennal segment three-fourths length of club; four regular rows of bristles on postantennal area of head (fig. 74)
 (European continent, Asia).....*silvatica silvatica* (Meinert), p. 36
 (British Isles).....*silvatica spectabilis* (Rothschild), p. 39
 (European Alps).....*silvatica fallax* (Rothschild), p. 41
9. Genal lobe less than one-half length of lower genal spine (fig. 43, *G.L.*)...10
 Genal lobe more than one-half length of lower genal spine (fig. 1, *G.L.*)...12

10. Only two rather slender spiniforms at frontodorsal angle of head; anal stylet three or more times as long as broad; usually with three antepygidial bristles (rarely four).....*scotti* I. Fox, p. 27
Three (rarely four) spiniforms at frontodorsal angle of head; anal stylet less than three times as long as broad; always with four antepygidial bristles11
11. Frontodorsal angle of head rather rounded (fig. 1); apical bristles of second antennal segment one-half length of club; sinus of posterior margin of seventh sternum fairly deep (fig. 40)
ebrighti (C. Fox), p. 24
Frontodorsal angle of head sharp (fig. 43); apical bristles on second antennal segment three-fourths length of club; sinus of posterior margin of seventh sternum very shallow, almost straight (fig. 46).....*draco* Hopkins, p. 26
12. Posterior margin of seventh sternum with deep sinus and large upper lobe (figs. 8, 24, 26).....13
Posterior margin of seventh sternum with very small sinus, or sinus concave and rather shallow (figs. 25, 27, 28).....14
13. Upper lobe on posterior margin of seventh sternum narrowly triangular, not convex dorsally, sinus narrow (figs. 8, 26) (eastern United States and Canada).....*hesperomys hesperomys* (Baker), p. 8
Upper lobe on posterior margin of seventh sternum broadly triangular, convex dorsally, sinus broad (fig. 24)
hesperomys pacifica Holland, p. 19
14. Anterior margin of head almost vertical (fig. 12); dorsal bristles on mesonotum thick and somewhat erect, particularly anteriorly (northern Rocky Mountain region)
hesperomys ravalliensis (Dunn), p. 14
Anterior margin of head oblique (fig. 11); dorsal bristles on mesonotum not noticeably thicker anteriorly (southwestern United States, Rocky Mountain area, Mexico)
hesperomys adelpha (Rothschild), p. 17

PEROMYSCOPSYLLA HESPEROMYS HESPEROMYS (Baker, 1904)

FIGURES 1-10, 15, 26, 37, 104-106

- Ctenopsyllus hesperomys* BAKER, Proc. U. S. Nat. Mus., vol. 27, pp. 427, 428, 452, 1904.
- Ctenopsylla hesperomys* C. FOX, U. S. Publ. Health Serv., Bull. U. S. Hyg. Lab. No. 97, p. 25, pl. 20, fig. 55, 1914.
- Leptopsylla hesperomys* ROTHSCILD, Nov. Zool., vol. 22, p. 304, 1915.—JORDAN, Nov. Zool., vol. 34, p. 186, 1928.
- Ctenopsylla hesperomys* WAGNER, Akad. Nauk S.S.S.R. Zool. Inst., Parazitol. Sbornik (Mag. Parasitol. Mus. Zool. Acad. Sci.), Leningrad, vol. 1, p. 147, 1930.
- Peromyscopsylla spinifrons* I. FOX, Proc. Ent. Soc. Washington, vol. 41, p. 48, 1939.
- Peromyscopsylla hesperomys* I. FOX, Fleas of the eastern United States, p. 84, pl. 23, figs. 117-119, 1940 (sinks *spinifrons*).—JELLISON and GOOD, U. S. Publ. Health Serv., Nat. Inst. Health Bull. 178, p. 122, 1942.

Peromyscopylla spinifrons, JELLISON and GOOD, U. S. Publ. Health Serv., Nat. Inst. Health Bull. 178, p. 123, 1942.

Peromyscopylla hesperomys HUBBARD, Fleas of western North America, p. 329, 1947 (part, not the records or drawings).

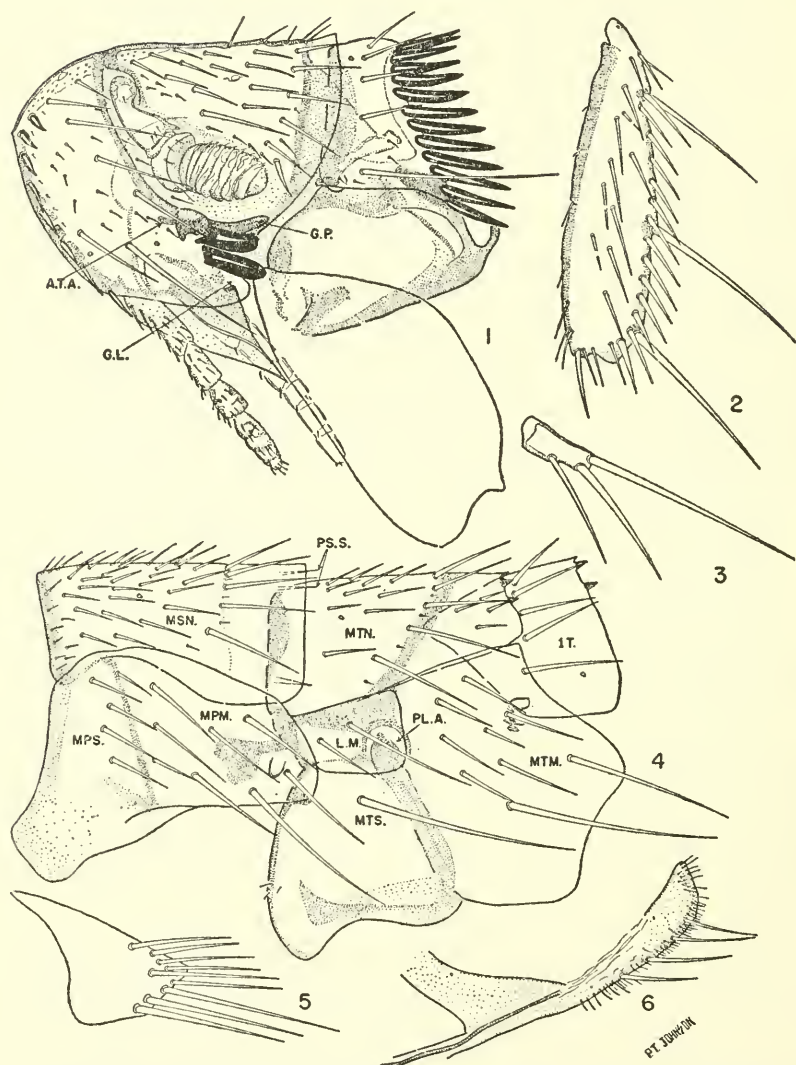
Peromyscopylla hesperomys hesperomys HOLLAND, Canada Dept. Agr. Techn. Bull. No. 70, pp. 176, 177, figs. 322, 324, f, 1949.

Head (fig. 1).—Preantennal area with three spiniforms at anterodorsal angle denoting frontal tubercle; below these five to seven medium-sized marginal bristles; two dorsomarginal bristles between spiniforms and upper margin of antennal groove; other than marginals, five long bristles arranged 1-2-2, and several small scattered bristles. Genal process (*G.P.*) visible above genal ctenidium; lower genal spine the longer; genal lobe (*G.L.*) more than one-half length of lower genal spine. (One female from Tennessee with three genal spines on one side (fig. 37), cf. *selenis* description.) Second segment of antenna with row of apical bristles on lateral surface not reaching beyond second segment of club in male, usually about three-fourths length of club in female, may reach apex. Postantennal area with four or five irregular rows of bristles.

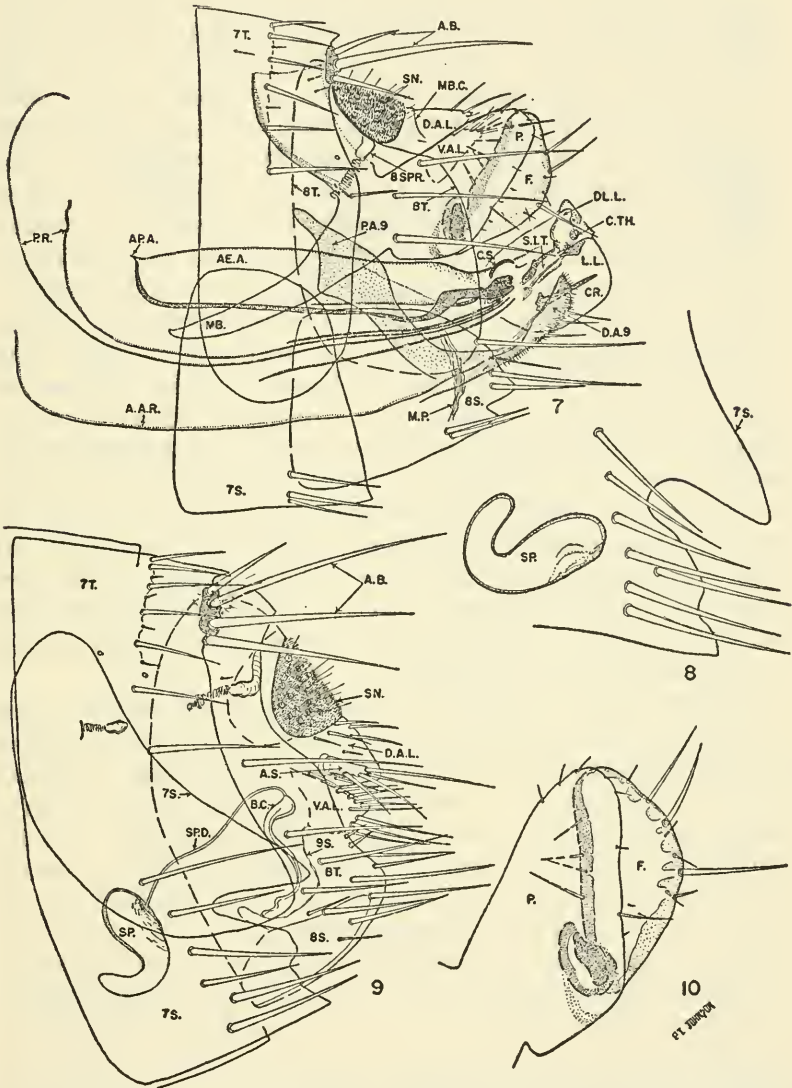
Thorax (fig. 4).—Pronotum with row of five or six long bristles on a side. Pronotal ctenidium with a total of 25-30 spines. Mesonotum (*MSN.*) with five or six rows of bristles, first five of which are irregular and of short bristles; dorsally with short, heavy, erect bristles from base to subapical row of long bristles. Mesepisternum (*MPS.*) with three or four bristles; mesepimere (*MPM.*) with three rows of bristles arranged 4-2-2 plus one bristle at posterior angle. Lateral metanotal area (*L.M.*) with two bristles, dorsal longest (variable in female). Metanotum (*MTN.*) with three rows of bristles. Metepisternum (*MTS.*) with one long bristle; metepimere (*MTM.*) with three rows of bristles but last row represented usually by a single long bristle.

Abdomen.—Typical terga with two rows of bristles, anterior of which may be very short or absent on more posterior segments; posterior row longer, reaching about to level of spiracles in male, well below this point in female. Basal abdominal sternum with two close-set bristles on ventral margin; typical sterna with row of three bristles in male, four to five in female. Male with three antepygidial bristles, middle longest; female with three or four, usually four.

Male (fig. 7).—Eighth tergum (*8T.*) with two rows of bristles below and posterior to spiracle, the first of two medium-sized bristles, second of about three much longer bristles. Eighth sternum (*8S.* and fig. 15) with rather sharply rounded upper lobe bearing two or three long bristles and one or two very small bristles apically; shallow



FIGS. 1-6.—*Peromyscopsylla hesperomys hesperomys*: 1, Head and prothorax, ♂; 2, tibia; 3, anal stylet, ♀; 4, thorax, ♂; 5, ventral anal lobe, ♀; 6, distal arm of ninth sternum, ♂. For explanation of symbols see pages 67-68.

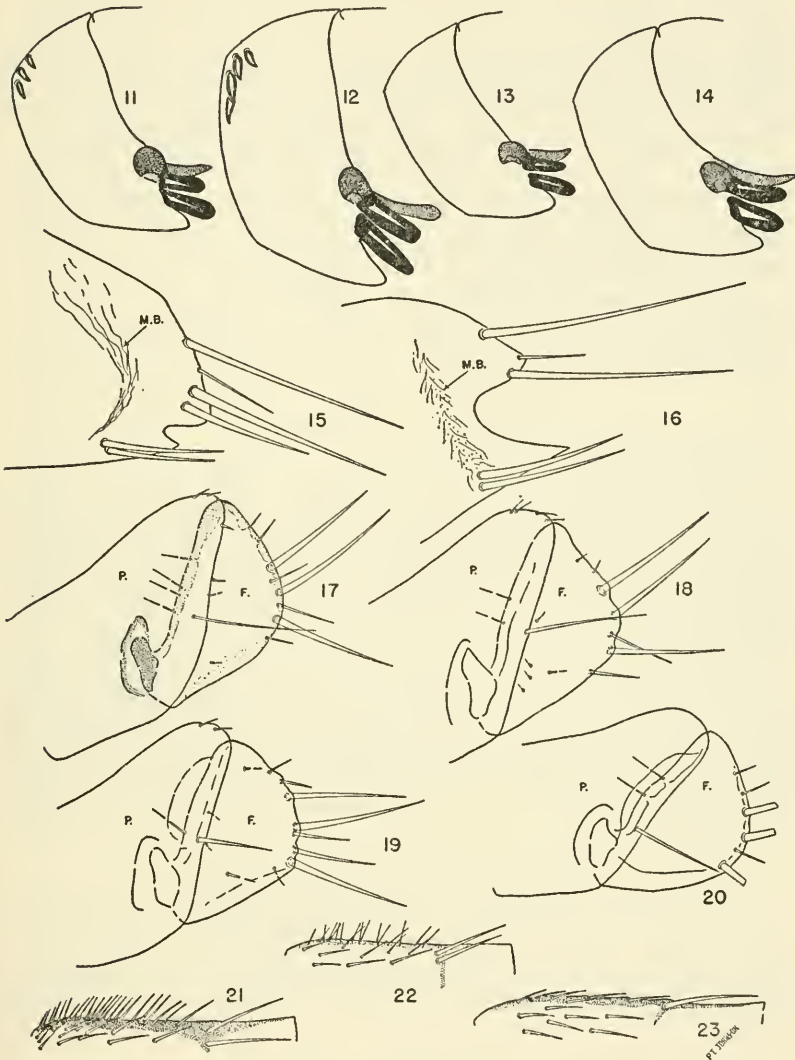


FIGS. 7-10.—*Peromyscopsylla hesperomys hesperomys*: 7, Modified segments, ♂; 8, seventh sternum and spermatheca, ♀; 9, modified segments, ♀; 10, immovable process and digitoid of male clasper. For explanation of symbols see pages 67-68.

distinct sinus between upper lobe and lower lobe; latter acuminate, very small, bearing a row of two or three ventral subapical bristles; membranous process (*M.P.*) associated with eighth sternum, visible only as vertical band on mesal surface. Immovable process of clasper (*P.* and fig. 10) with narrowly rounded apex; dorsal margin at least two times as long as ventral, long, oblique; ventral margin subhorizontal (average measurements: ventral, 81 microns; dorsal, 205 microns); bearing apically two or three very small bristles and on straight posterior margin a characteristic small bristle about one-half as long as greatest width of digitoid (average length 48 microns) and inserted well below middle of margin. Digitoid or movable finger of clasper (*F.* and fig. 10) with posterior margin evenly and broadly convex from base to apex; almost always more than two times as long as broad (average width, 86 microns; length, 196 microns); area of greatest width about at middle; with three long bristles and two or three smaller ones on posterior margin; with several small mesal and lateral bristles and three or four long slender bristles on rather straight anterior margin. Distal arm of ninth sternum (*D.A.g.*, and fig. 6) not as long as proximal arm (*P.A.g.*); with apex subtruncate but upper angle acuminate and extending distad of arcuate ventral margin; entire posterior (ventral) margin clothed with short, thin bristles and with about four long ventral bristles; anterior (dorsal) margin semimembranous most of its length.

Aedeagus (figs. 7, 104-106).—Aedeagal apodeme (*AE.A.*) about five times as long as broad. Distolateral lobe (*DL.L.*) about twice as long as broad; basal half weakly sclerotized and indistinct; subovate, but somewhat narrow near midpoint. Central thickening (*C.TH.*) fairly well developed. Lateral lobes unspecialized, broad, usually minutely spiculate subapically. Median dorsal lobe (*M.D.L.*) weakly sclerotized. Sclerotized inner tube (*S.I.T.*) four times as long as broad; its armature (*A.I.T.*) represented as a dorsal basal thickening which terminates in a short spur below midpoint; lacking a lateral or ventral sclerotization or keel. Apex of sclerotized inner tube (*A.S.I.*) dorsally produced into a vertical arm. Band of inner tube (*B.I.T.*) reduced but distinct, appearing as a short apical extension from apex of inner tube. With a conspicuous fulcrum (*FM.*) extending from ventral portion of *S.I.T.* to base of *DL.L.* in vicinity of central thickening (*C.TH.*). Crochets (*CR.*) represented only by very long, narrow, acuminate, daggerlike structures, longer than *S.I.T.* Accessory lateral lobe (*A.L.L.*) acuminate.

There are apparently no significant differences in the aedeagi of the subspecies of *hesperomys*.



FIGS. 11-23.—Subspecies of *Peromyscopylla*: 11, Preantennal area of head, *P. hesperomys pacifica*, ♀; 12, same, *P. h. ravalliensis*, ♀; 13, same, *P. h. pacifica*, ♂; 14, same, *P. h. ravalliensis*, ♂; 15, eighth sternum and digitoid of male clasper, *P. h. pacifica*; 16, same, *P. h. pacifica*, ♂; 17, immovable process and digitoid of male clasper, *P. h. pacifica*; 18-20, same, *P. h. ravalliensis*; 21, dorsal portion of male mesonotum, *P. h. ravalliensis*; 22, same, *P. h. adelpha*; 23, same, *P. hamifer vigens*. For explanation of symbols see pages 67-68.

Female (fig. 9).—Seventh sternum (7*S.* and fig. 8) with large triangular subacuminate upper lobe followed by deep, rather narrow sinus; lower lobe wider than width of sinus, posterior border usually quite convex, at times irregular in outline. Eighth tergum (8*T.*) with four or five small bristles above spiracle; below spiracle with one long bristle mediolaterally; a group of long and shorter bristles below and posterior to this, some of these mesal. Anal stylet (*A.S.* and fig. 3) about $2\frac{3}{4}$ times as long as wide, with one long apical bristle and two shorter ventromarginal bristles. Spermatheca (*SP.* and fig. 8) with evenly oval head; tail narrow, not as long as head.

Length.¹—Male, 2.0–2.8 mm.; female, 2.1–2.8 mm.

Holotype.—Female, U.S.N.M. No. 6924, from *Peromyscus* sp., Franconia, N. H.

RECORDS OF SPECIMENS EXAMINED

CANADA. Ontario (*Peromyscus* sp.).

UNITED STATES. Massachusetts: Franklin County (*Peromyscus leucopus*); Norfolk County (*P. l. noveboracensis*). Michigan: Wayne County (*Canis familiaris*). New Hampshire: Carroll County (*Peromyscus maniculatus gracilis*). New York: Albany County (*P. leucopus noveboracensis*); Green County, "mouse nest" (*P. maniculatus*, *P. m. gracilis*); Tompkins County, "deer mouse" (*Peromyscus* sp., *P. leucopus*, *P. l. leucopus*). Ohio: Hocking County (*Peromyscus* sp.). Pennsylvania: Berks County (*P. leucopus*); Monroe County (*P. leucopus*, *P. maniculatus gracilis*); Pike County (*P. maniculatus*); Wayne County (*P. leucopus noveboracensis*). South Carolina: Georgetown County, "white-footed mouse." Tennessee: Great Smoky Mountains National Park (*P. maniculatus nubiterrae*). Vermont: Rutland County, "mouse nest" (*P. leucopus noveboracensis*). Virginia: Augusta County (*P. maniculatus nubiterrae*); Montgomery County, "mouse." West Virginia: Pendleton County, nest of *Neotoma*.

(INTERGRADES WITH *hesperomys adelpha*)

UNITED STATES. North Dakota: Morton County (*Microtus pennsylvanicus*). South Dakota: Custer County (*Clethrionomys gapperi brevicaudus*, *Peromyscus* sp., *P. maniculatus*); Meade County (*Clethrionomys* sp.); Pennington County (*Peromyscus maniculatus*). Wyoming: Crook County (*Peromyscus* sp.).

PEROMYSCOPSYLLA HESPEROMYS RAVALLIENSIS (Dunn, 1923), new status

FIGURES 12, 14, 18–21, 27, 28

Ctenopsyllus ravalliensis DUNN, in Dunn and Parker, U. S. Publ. Health Serv., Publ. Health Rep. No. 38, pp. 2768–2775, 1923.

Ctenopsylla ravalliensis WAGNER, Akad. Nauk S.S.S.R. Zool. Inst., Parazitol. Sbornik (Mag. Parasitol. Mus. Zool. Acad. Sci.), Leningrad, vol. 1, p. 147, 1930.

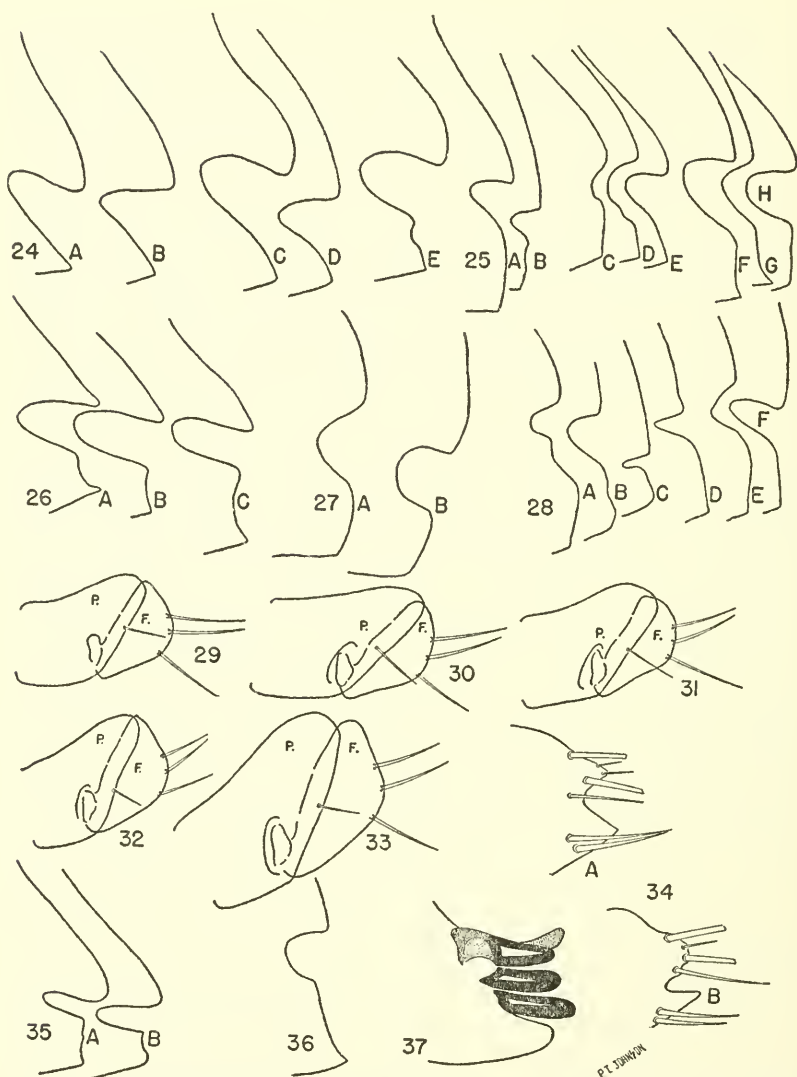
¹ These measurements included only when sufficient series available.

Ctenopsylla ravalliensis (sic) WAGNER, Canadian Ent., vol. 68, p. 205, fig. 10, 1936.

Peromyscopsylla ravalliensis JELLISON and GOOD, U. S. Publ. Health Serv., Nat. Inst. Health Bull. 178, p. 122, 1942.—HUBBARD, Fleas of western North America, pp. 329, 332, fig. 199, 1947 (part, some of records listed are *hesperomys adelpha* (Rothschild, 1914).—HOLLAND, Siphonaptera of Canada, pp. 175, 177, figs. 316-318, map 41, 1949.

This subspecies of *hesperomys* is somewhat larger than the others and may be further distinguished from the other forms by a number of relative differences. In both male and female (but more marked in the male) the dorsum of the mesonotum is thickly covered, especially anteriorly, with rather coarse, erect bristles (fig. 21), not with much finer and/or less abundant erect bristles (figs. 4, 22). The anterior margin of the head is more vertical, and the angle at insertion of the labrum is less marked than in the other subspecies (figs. 12, 14); the female (and more rarely the male) may have four frontal spiniforms rather than three (fig. 12). In the male the ventral margin of *P.* is more than one-half the length of the dorsal margin, the ventral margin measuring 110-119 microns, the dorsal margin measuring 167-181 microns, not 72-110 microns (ventral margin) and 134-167 microns (dorsal margin), as is the case in *hesperomys adelpha* and *h. pacifica*; the digitoid (figs. 18-20, *F.*) is consistently larger than the two subspecies mentioned above, measuring in length 81-91 microns, and in breadth 143-162 microns, i.e., markedly less than two times as long as broad; the area of greatest width at middle. In the male, the eighth sternum bears on the upper lobe almost always at least three long bristles and one or two smaller ones; the sinus is deeper and the upper lobe is broader than in *h. hesperomys* (fig. 34). The sinus on the posterior margin of the female seventh sternum varies greatly from a very narrow, small ventral sinus to a much larger sinus located more laterally (figs. 27 (allotype), 28).

Holland (1949) has stated that the usual hosts of *h. ravalliensis* are members of the genus *Neotoma*, other records usually being from animals closely associated with wood rats. This certainly appears to be the case; the only records we have other than *Neotoma* are from animals to be found in the same habitat as *Neotoma*, and taken in association with it. Hubbard's records (1947) of this flea from *Neotoma*, Wallowa, Oreg., indicate that the likely range of *hesperomys ravalliensis* is the more northerly Rocky Mountain region, and west into eastern Oregon. However it is felt that some records of *h. ravalliensis* from wood rats bear further checking, since undeniably this subspecies could be confused with *h. adelpha*, particularly since



FIGS. 24-37.—Subspecies of *Peromyscopsylla hesperomys*: 24,a-e, Seventh sternum, *P. h. pacifica*, ♀; 25,a-h, same, *P. h. adelpha*, ♀; 26,a-c, same, *P. h. hesperomys*, ♀; 27,a,b, same, *P. h. ravalliensis*, allotype ♂; 28,a-f, same, *P. h. ravalliensis*, ♀; 29-31, immovable process and digitoid of male clasper, *P. h. adelpha*; 32, same, *P. hesperomys* (intergrade), Crook County, Wyo.; 33, same, *P. hesperomys* (intergrade), Pennington County, S. Dak.; 34,a,b, eighth sternum, *P. h. adelpha*, ♂; 35,a,b, seventh sternum, *P. hesperomys* (intergrade), ♀, Crook County, Wyo.; 36, same, *P. hesperomys* (intergrade), ♀, Pennington County, S. Dak.; 37, genital area showing three spines, *P. h. hesperomys*, ♀, Tennessee. For explanation of symbols see pages 67-68.

a great deal of reliance has been placed on host preference in determination of this flea.

Length.—Male, 2.1–2.2 mm.; female, 2.1–2.5 mm.

Types.—Holotype, male, U.S.P.H.S. Hygienic Laboratory No. 199-6, from *Neotoma* sp., Tin Cup Creek, southwest of Darby, Mont.; allotype, female, U.S.P.H.S. Hygienic Laboratory No. 161-6, from *Neotoma* sp., Spoon Creek, southwest of Darby, Mont.

RECORDS OF SPECIMENS EXAMINED

CANADA. British Columbia (*Ochotona* sp., *Peromyscus* sp., *Neotoma* sp., *N. cinerea*).

UNITED STATES. Montana: Ravalli County, "pack rat," "pine squirrel," "mountain rat," "wood rat." Utah: Cache County (*Neotoma cinerea*: one female, determination questionable).

PEROMYSCOPSYLLA HESPEROMYS ADELPHA (Rothschild, 1915)

FIGURES 22, 25, 29–31, 34

Leptopsylla adelpha ROTHSCHILD, Nov. Zool., vol. 22, p. 304, fig. 4, June 1915.—

JORDAN and ROTHSCHILD, Ectoparasites, vol. 1, p. 58, fig. 63, December 1915.

Ctenopsylla adelpha WAGNER, Akad. Nauk S.S.S.R. Zool. Inst., Parazitol. Sbornik (Mag. Parasitol. Mus. Zool. Acad. Sci.), Leningrad, vol. 1, p. 147, pl. 13, fig. 90, 1930 (part, figure and description are *draco* Hopkins, 1951).

Peromyscopsylla hemisphaerium STEWART, Pan-Pacific Ent., vol. 16, p. 25, figs. 16, 17, 1940 (new synonymy).

Peromyscopsylla adelpha JELLISON and GOOD, U. S. Publ. Health Serv., Nat. Inst. Health Bull. 178, p. 121, 1942.

Peromyscopsylla hemisphaerium HUBBARD, Fleas of western North America, pp. 329, 331, fig. 198, 1947.

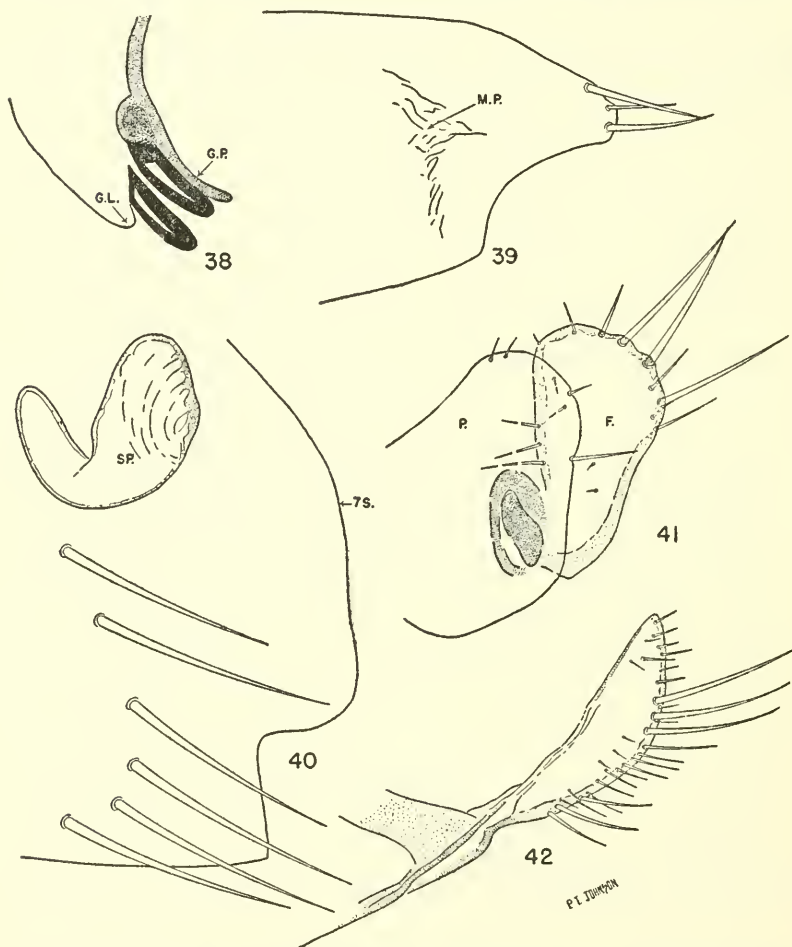
Peromyscopsylla adelpha HUBBARD, Fleas of western North America, p. 336, fig. 202, 1951 (part, male description and figures are *draco* Hopkins).

Peromyscopsylla hesperomys hemisphaerium HOLLAND, Canada Dept. Agr. Techn. Bull. No. 70, p. 117, figs. 323, 324, h, 1949.—HOPKINS, Ann. Mag. Nat. Hist., ser. 12, vol. 4, p. 541, 1951.

Peromyscopsylla hesperomys adelpha HOPKINS, Ann. Mag. Nat. Hist., ser. 12, vol. 4, p. 541, 1951.

This subspecies of *hesperomys* is smaller than *hesperomys hesperomys* and *h. ravalliensis* and may be distinguished in the male from *h. hesperomys* by the following points: The characteristic bristle on the posterior margin of *P.* is usually longer than one-half width of *F.* (figs. 29–31); the ventral and dorsal margins of *P.* are almost parallel, not widely divergent, as in the type subspecies, and the ventral margin is more than one-half the length of the upper (average measurements: upper, 148 microns, lower 95 microns). The shape of *F.* distinguishes this subspecies from *hesperomys pacifica* and *hesperomys*

ravalliensis. *F.* is less than two times as long as broad (average length 124 microns, width 67 microns), usually with area of greatest width above middle, though in some specimens *F.* is hemispherical in outline



FIGS. 38-42.—*Peromyscopsylla ebrighi*: 38, Genal area, ♂; 39, eighth sternum, ♂; 40, seventh sternum and spermatheca, ♀; 41, immovable process and digitoid of male clasper; 42, distal arm of ninth sternum, ♂. For explanation of symbols see pages 67-68.

(figs. 29-31). It will be seen that the shape of *F.* is quite variable, and all variations were found in a single collection from *Peromyscus*, Nye County, Nev. A series of paratypes of *P. hemisphaerium* fall well within this range of variation. The female is distinguished from the other subspecies (except *hesperomys ravalliensis*) by the shape

of the posterior margin of the seventh sternum, the sinus being much wider, dorsal lobe much shorter and the lower lobe short and truncate; at times the margin may be almost straight (fig. 25), at times with a broken margin. Both male and female, especially the male, have thin, erect bristles on the mesonotum dorsally (fig. 22).

Length.—Male, 1.7–2.0 mm.; female, 2.0–2.3 mm.

Holotype.—Female, from “Mus,” Paradise, Ariz., Nov. 21, 1913.

Peromyscopsylla hesperomys adelpha probably ranges from northern California south into Mexico and east into western Texas, Nebraska, Colorado, the Dakotas, and southern Alberta. Intergrades between *h. hesperomys* and *h. adelpha* have been found in Wyoming, North Dakota, and South Dakota (figs. 32, 33, 35, 36). It is interesting to note that in one case a male and female taken from the same animal showed characteristics of *h. hesperomys* and *h. adelpha* respectively (figs. 33, 36).

RECORDS OF SPECIMENS EXAMINED

CANADA. Alberta (*Peromyscus* sp.).

MEXICO. Michoacán (*Peromyscus* sp.).

UNITED STATES. Arizona: Apache County (*Peromyscus boylii*); Coconino County (*Microtus rufinus*); Yavapai County (*Peromyscus truei*). California: Alameda County (*Perognathus* sp., *Peromyscus* sp.); Inyo County (*Peromyscus maniculatus*); Lassen County (*P. maniculatus*); Monterey County (*Peromyscus* sp., *P. californicus*, *P. truei*); Nevada County (*P. maniculatus*); Plumas County (*Microtus longicaudus*, *Peromyscus boylii*, *P. maniculatus*). Colorado: Clear Creek County (*Peromyscus maniculatus*); Summit County (*Peromyscus* sp.); Washington County, “chipmunk.” Montana: Custer County (*Peromyscus maniculatus*); Dawson County (*P. maniculatus*); Powder River County (*P. maniculatus*); Rosebud County (*Onychomys leucogaster*, *Peromyscus maniculatus*). Nebraska: Dawes County (*Peromyscus maniculatus*); Sioux County (*P. maniculatus*). Nevada: Douglas County (*Peromyscus maniculatus*); Ormsby County (*P. maniculatus*); Nye County (*P. maniculatus*). New Mexico: Bernalillo County (*P. maniculatus*); Colfax County (*P. maniculatus*); Lincoln County (*P. boylii*, *P. leucopus*, *P. truei*); Rio Arriba County (*P. maniculatus*, *P. truei*); San Juan County (*P. maniculatus*); Santa Fe County (*Peromyscus* sp., *P. truei*, *Dipodomys ordii*); Taos County (*Peromyscus maniculatus*); Valencia County (*P. boylii*). Texas: Terry County (*Onychomys leucogaster*, *Peromyscus* sp.). Utah: Beaver County (*Peromyscus* sp.); Box Elder County (*Peromyscus* sp.); Millard County (*P. truei*); San Juan County (*Onychomys leucogaster*, *Peromyscus maniculatus*); Washington County (*P. maniculatus*).

PEROMYSCOPSYLLA HESPEROMYS PACIFICA Holland, 1949

FIGURES 11, 13, 16, 17, 24

Peromyscopsylla hesperomys (Baker) HUBBARD, Fleas of western North America, p. 329, 1947 (part) (nec Baker, 1904).

Peromyscopsylla hesperomys pacifica HOLLAND, Canada Dept. Agr. Techn. Bull. No. 70, p. 176, pl. 40, figs. 319-321, 324,a-e, map 41, 1949.

Differs from other subspecies of *hesperomys* in details of *P.* and *F.* in the male, the seventh sternum in the female, and the dorsal bristles of the mesonotum, which are fine and erect, especially in the male. In the male, the dorsal and ventral margins of the immovable process of the clasper (fig. 17, *P.*) are almost parallel, not markedly divergent as in *h. hesperomys*, the length of the lower being more than one-half the upper (average length: lower, 95 microns; upper, 153 microns). The characteristic bristle on the posterior margin of *P.* is usually more than one-half the width of the movable finger, not less (average, 57 microns); *F.* (fig. 17) is about two times as high as long, or more (average length, 138 microns; width, 72 microns), triangular in shape, with posterior angle about at midpoint, in absolute length somewhat longer than *h. adelpha*, and definitely narrower than in *h. ravalliensis*. Eighth sternum with narrowly rounded upper lobe, not as broad as in *h. hesperomys*, bearing usually two long bristles and one short one; sinus between upper and lower lobes quite deep, not shallow as in *h. hesperomys*. In the female, *h. pacifica* may be distinguished by the fact that the upper lobe of the posterior margin of the seventh sternum (fig. 24) is broader and more convex dorsally than in *h. hesperomys*, and the sinus is much broader; in cases where actual breakage of the margin of the lower lobe has not occurred, this portion is evenly and broadly convex.

Peromyscopsylla hesperomys pacifica ranges from the west coast of British Columbia, Washington, and Oregon, east to the Cascade and Coastal Mountain ranges.

Length.—Male, 1.95-2.1 mm.; female, 1.8-2.45 mm.

Types.—Holotype, male, and allotype, female, Canadian National Collection, Ottawa, from *Peromyscus* sp., University of British Columbia campus, Vancouver, British Columbia, Canada.

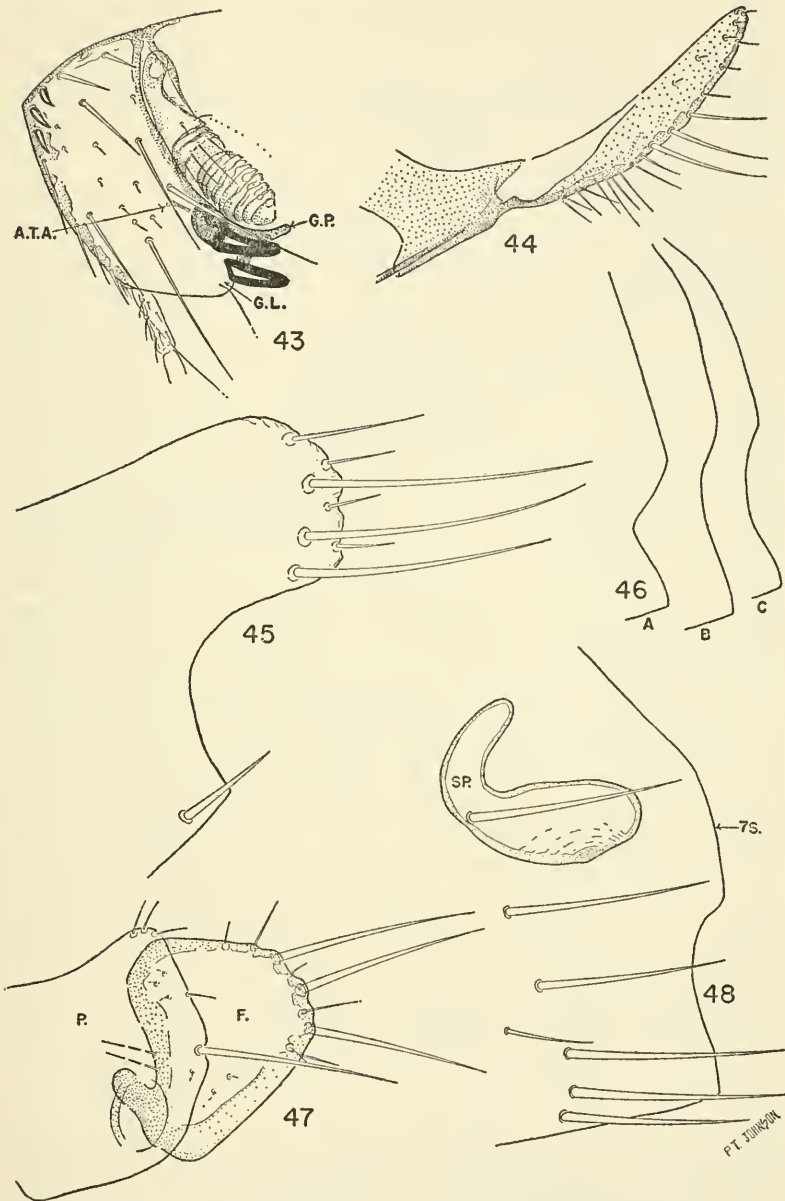
RECORDS OF SPECIMENS EXAMINED

CANADA. British Columbia (*Microtus oregoni serpens*, *Peromyscus* sp., *P. maniculatus*, *P. m. austerus*, *P. m. interdictus*, *P. m. oreas*).

UNITED STATES. Oregon: Clackamas County (*Peromyscus maniculatus rubidus*); Hood River County (*P. m. gambeli*); Linn County (*P. m. rubidus*); Multnomah County (*P. m. rubidus*). Washington: Lewis County (*P. maniculatus*).

DISCUSSION OF THE SUBSPECIES OF *P. hesperomys*

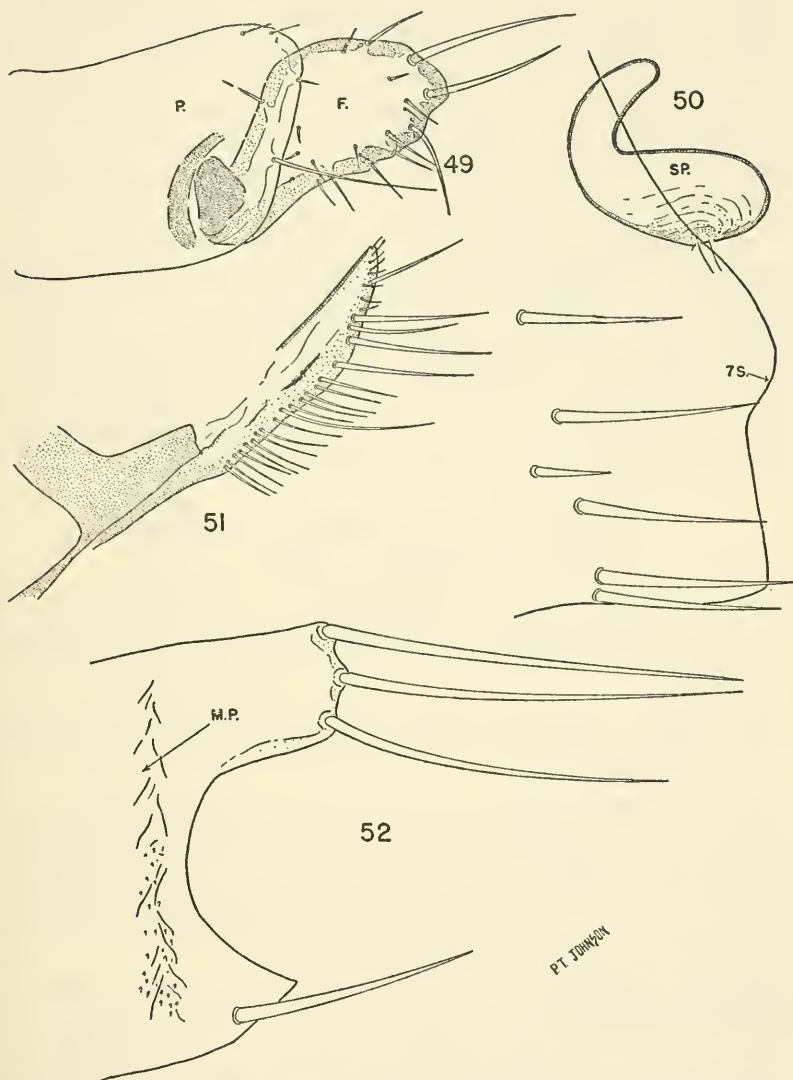
Peromyscopsylla hesperomys has long been regarded as a typical parasite of eastern *Peromyscus*. Records of the occurrence of this



FIGS. 43-48.—*Peromyscopsylla draco*: 43, Preantennal area of head, ♂; 44, distal arm of ninth sternum, ♂; 45, eighth sternum, ♂; 46, a-c, seventh sternum, ♀; 47, immovable process and digitoid of male clasper; 48, seventh sternum and spermatheca, ♀. For explanation of symbols see pages 67-68.

species in the far western United States and Canada, published during recent years, have surprised workers in the field. This experience has been duplicated with another characteristic flea of eastern *Peromyscus*, *Orchopeas leucopus* (Baker, 1904), which has been taken in Utah, Texas, Arizona, New Mexico, California, and even Chihuahua, Mexico (unpublished records of authors).

The subspecies of *Peromyscopsylla hesperomys* present a very interesting problem in regard to their various morphological and distributional patterns. Dr. Karl Jordan, F.R.S., has previously noted the interesting fact that subspeciation of fleas from north to south does not occur in the eastern part of North America, whereas the same species may form several variants both from north to south and from east to west in the western part of North America (Jordan, 1928). The pattern presented by *hesperomys* is an excellent example of this fact in that *h. hesperomys* from Tennessee or the Carolinas is indistinguishable from *h. hesperomys* taken in New York or the New England States. Western *hesperomys* has, on the other hand, formed three subspecies recognizable on morphological grounds. The geographic distribution of these subspecies is rather puzzling. *P. h. pacifica*, found mainly on *Peromyscus*, is apparently confined to the western slopes of the Cascade Range (Oregon and Washington) and the coastal mountains of British Columbia. *P. h. ravalliensis* seems to be typically found on *Neotoma* in the western slopes of the northern Rocky Mountains, including the Monachee Mountains of eastern British Columbia, the Bitterroot Range in western Montana, perhaps as far south as the Wasatch Mountains in northeastern Utah (Utah range based on one specimen, a female, from *Neotoma*, Cache County, doubtfully determined as *h. ravalliensis* by the authors), and reaching the Blue Mountains of northeastern Oregon and the Salmon River Mountains of Idaho based on Hubbard's interesting records from *Neotoma*, Wallowa Lake, Oreg. The range of these two subspecies is understandable for both ecological and geographical reasons, i.e., mountain barriers and host differences. *P. h. adelpha*, undoubtedly a morphological entity has a far greater range than the above forms despite the natural barriers involved. This subspecies is found in the coastal range of California; in the Sierras of California and Nevada on both eastern and western slopes, in the southern Rocky Mountains on both eastern and western slopes (Arizona, Utah, New Mexico, Colorado, Wyoming), and on the plains of Texas, Colorado, Nebraska, and Alberta. Two females which may be this subspecies were taken in Michoacán, Mexico, a very southerly record. The only western area (west of about the 103d meridian) not occupied by *h. adelpha*, regardless of



FIGS. 49-52.—*Peromyscopsylla scotti*: 49, Immoveable process and digitoid of male clasper; 50, seventh sternum and spermatheca, ♀; 51, dorsal arm of ninth sternum, ♂; 52, eighth sternum, ♂. For explanation of symbols see pages 67-68.

topography or the usual geographical barriers of mountain ranges, rivers, etc., is that inhabited by the other two western subspecies. As well as possessing an extremely wide and geographically variable range, *h. adelpha* presents relatively great morphological variation, particularly in the male (figs. 29-31), as compared to the variations found within any of the other subspecies (figs. 7, 10, *h. hesperomys*; 18-20, *h. ravalliensis*; and 17, *h. pacifica*). These variations cannot be correlated with distribution and, in fact, are exhibited in a series taken from the same individual host.

Intergradations between *h. adelpha* and *h. hesperomys*, as may be expected, occur in the plains area of western North and South Dakota and eastern Wyoming near the South Dakota border. In these particular regions neither true *h. hesperomys* nor typical *h. adelpha* have as yet been found. No intergrades between the other subspecies have been recognized during the course of this study. In this regard, it is pointed out that in the Dakota regions there are no isolating factors which would prevent intergradation and hybridization.

PEROMYSCOPSYLLA EBRIGHTI (C. FOX, 1926)

FIGURES 38-42, 109, 110

- Leptopsylla ebrighi* C. FOX, Pan-Pacific Ent., vol. 2, p. 182, figs. 3, 4, 1926.
Ctenopsylla ebrighi WAGNER, Akad. Nauk S.S.S.R. Zool. Inst., Parazitol. Sbornik (Mag. Parasitol. Mus. Zool. Acad. Sci.), Leningrad, vol. 1, p. 147, 1930.
Peromyscopsylla ebrighi JELLISON and GOOD, U. S. Publ. Health Serv., Nat. Inst. Health Bull. 178, p. 121, 1942.—HUBBARD, Fleas of western North America, p. 335, 1947.

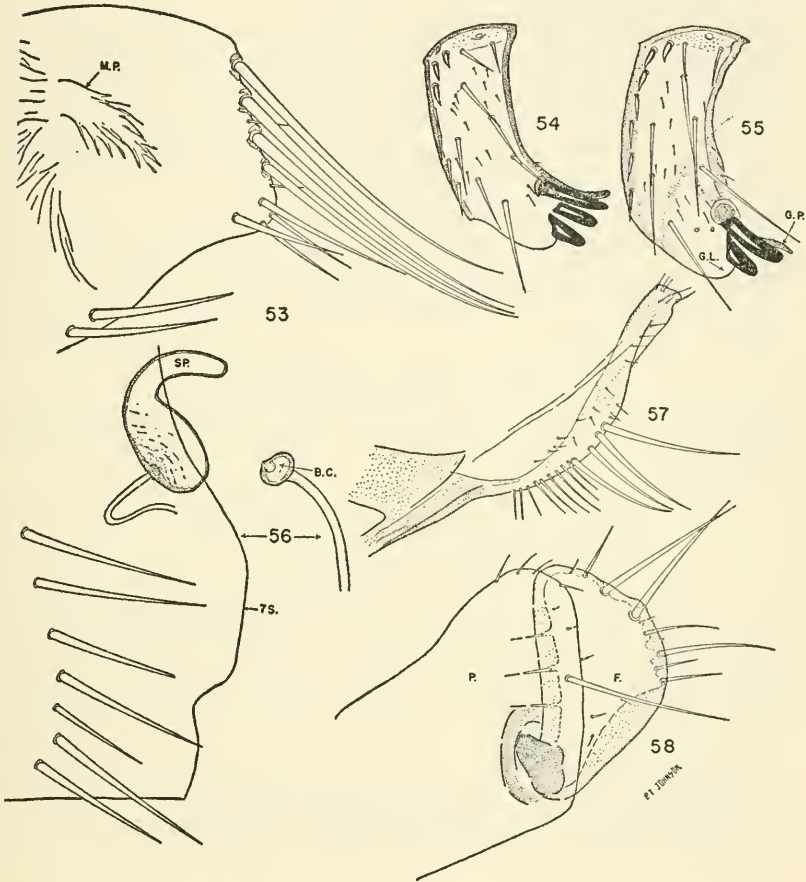
Head.—Similar to *hesperomys* except: female with three or four spiniforms opposite frontodorsal angle; genal lobe (fig. 38, *G.L.*) less than one-half length of lower genal spine; second antennal segment with marginal bristles not reaching beyond second segment of club in male and about one-half length of club in female.

Thorax.—Essentially as in *hesperomys* except lacking erect bristles dorsally on mesonotum.

Abdomen.—As in *hesperomys*.

Male.—Eighth tergum mediolaterally with two rows of two to three long bristles each. Eighth sternum (fig. 39) with caudal margin ventrally emarginate, producing broad dorsal lobe bearing three apical bristles, one of these shorter than others; ventrally with one or no bristles; membranous process (*M.P.*) very small. Immovable process of clasper (fig. 41, *P.*) with bluntly rounded apex; characteristic bristle on posterior margin not as long as width of digitoid. Digitoid

or movable finger of clasper (*F.*) twice as long as broad at maximum, with area of greatest width near apex; apex rounded, this area bearing three long bristles on posterior margin; below these, margin slightly concave to subrounded posteroventral angle; anterior margin quite



FIGS. 53-58.—*Peromyscopsylla selenis*: 53, Eighth sternum, ♂; 54, preantennal area showing three genal teeth, ♂, Plumas County, Calif.; 55, normal preantennal area, ♂; 56, seventh sternum, spermatheca, and bursa copulatrix, ♀; 57, distal arm of ninth sternum, ♂; 58, immovable process and digitoid of male clasper. For explanation of symbols see pages 67-68.

straight, bearing two or three long thin bristles. Distal arm of ninth sternum (fig. 42) with dorsal (anterior) margin proximally semi-membranous; with convex posterior (ventral) margins; apex subacute; posterior margin with many marginal and submarginal bristles, three of these very stout, and longer than others.

Aedeagus (figs. 109, 110).—Essentially as in *hesperomys* but with following differences: crochets (*CR.*) broader throughout their lengths, but of same general type; distolateral lobe (*DL.L.*) about three times as long as broad. Central thickening (*C.TH.*) weakly sclerotized, inapparent.

Female.—Posterior margin of seventh sternum (fig. 40) with a fairly deep sinus; above sinus with a subrounded lobe; below sinus, margin somewhat oblique, straight. Anal stylet about two times as long as wide; with two apical bristles, one longer than other, or with one long apical bristle and one shorter ventral subapical bristle. Spermatheca (fig. 40, *SP.*) as in *hesperomys*.

Length.—Male 1.8–2.25 mm.; female 2.5–2.8 mm.

Types.—Holotype, male, and allotype, female, U.S.N.M. No. 28919, from *Neotoma fuscipes* Baird, Los Angeles, Calif.

The apparent range of this species is coastal and southern California.

RECORDS OF SPECIMENS EXAMINED

UNITED STATES. California: Los Angeles County (*Peromyscus californicus insignis*); Monterey County (*P. californicus*); San Diego County (*Dipodomys* sp., "mouse").

PEROMYSCOPSYLLA DRACO Hopkins, 1951

FIGURES 43–48, 108

Leptopsylla adelpha ROTHSCHILD, in Jordan and Rothschild, Nov. Zool., vol. 22, p. 304, fig. 4, December 1915 (nec Rothschild, Ectoparasites, vol. 1, p. 58, fig. 63, June 1915).

Ctenopsylla adelpha WAGNER, Akad. Nauk S.S.S.R. Zool. Inst., Parazitol. Sbornik (Mag. Parasitol. Mus. Zool. Acad. Sci.), Leningrad, vol. 1, p. 147, pl. 13, fig. 90 (part), 1939.

Peromyscopsylla adelpha JELLISON and GOOD, U. S. Publ. Health Serv., Nat. Inst. Health Bull. 178, p. 121 (part), 1942.—HUBBARD, Fleas of western North America, p. 336 (part, female is *hesperomys adelpha*), 1947.

Peromyscopsylla draco HOPKINS, Ann. Mag. Nat. Hist., ser. 12, vol. 4, p. 541, 1951.

Head (fig. 43).—Similar to *hesperomys* except: frontal angle much more marked, head less rounded above and below this angle than in *hesperomys* (fig. 1); genal lobe (*G.L.*) less than one-half length of lower genal spine; second segment of antenna with row of apical bristles usually less than one-half, sometimes three-fourths, length of club; in female three-fourths length of club.

Thorax.—As in *hesperomys*, except mesonotum without erect bristles dorsally.

Abdomen.—As in *hesperomys*.

Male.—Eighth tergum with two rows of bristles mediolaterally, arranged 2-3; those of last row long. Eighth sternum (fig. 45) with no membranous process visible; dorsoapically rounded; bearing four long submarginal and three or four short posteromarginal bristles; with deep sinus from lowest apical bristle to ventral margin, which bears one submarginal bristle. Immovable process of clasper (fig. 47, *P.*) about as broad as long; posterior margin rounded with characteristic bristle inserted below midpoint and in length exceeding greatest width of digitoid. Movable finger or digitoid of clasper (*F.*) rather wedge-shaped with blunt apex at insertion in *P.*; with sinuate anterior margin bearing two or three thin bristles; dorsally, gently rounded to area of greatest width; with three long marginal bristles near dorsocaudal angle and several smaller ones; posterior margin below these straight to level of insertion in *P.* Distal arm of ninth sternum (fig. 44) narrow; basal half of dorsal (anterior) margin semimembranous; apex subacute, bearing several very small bristles; ventral (posterior) margin with three or four rather long bristles near midpoint; many shorter bristles distally and proximally; a few very small bristles laterally.

Aedeagus (fig. 108).—Essentially as in *hesperomys* but with dagger portion of crochets (*CR.*) broader; base of crochet narrower, not expanded. Apex of distolateral lobe (*DL.L.*) with margins fairly straight or concave, not ovate.

Female.—Posterior margin of seventh sternum (figs. 46, 48) with broad flat "lobe" followed by shallow ventral concavity. Spermatheca (fig. 48, *SP.*) as in *hesperomys*. Anal stylet about two times as long as broad; bearing one long apical bristle and one shorter ventral subapical bristle.

Holotype.—Male, from "*Mus*," Paradise, Ariz., Feb. 10, 1914.

The range of *P. draco* is not known, but probably includes the southwestern United States and northern Mexico.

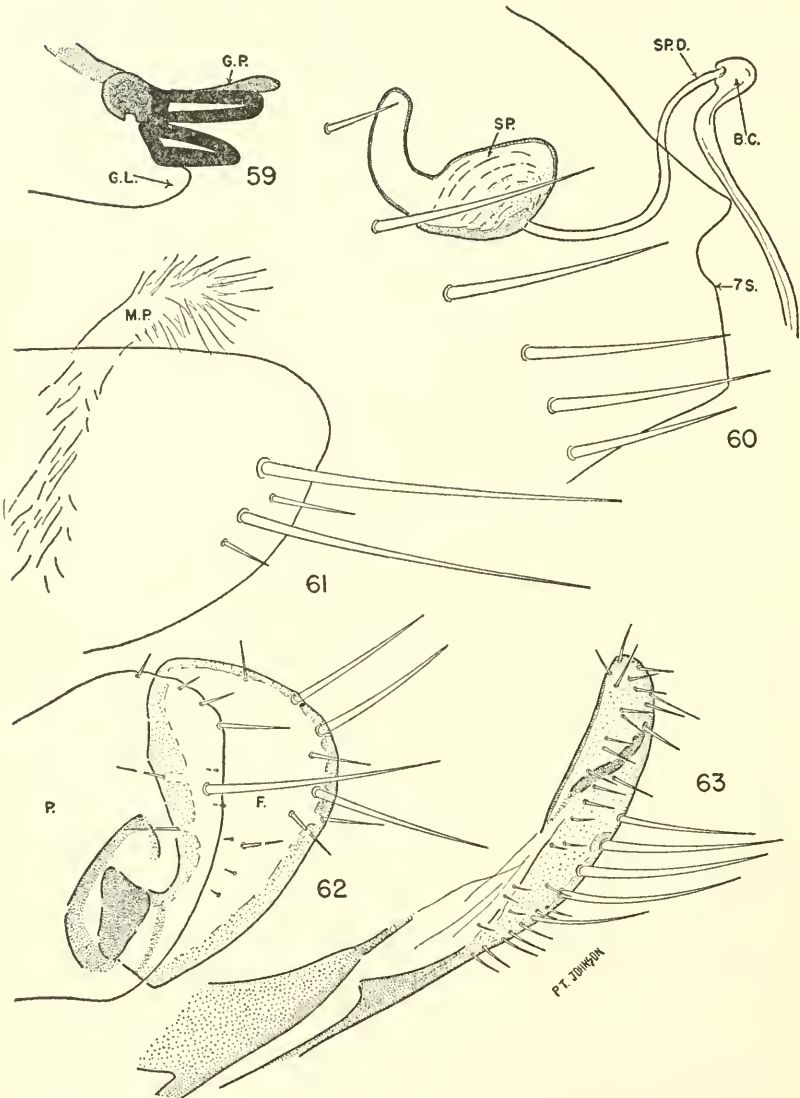
RECORDS OF SPECIMENS EXAMINED

UNITED STATES. New Mexico: Grant County (*Neotoma albigula*); Sante Fe County (*Peromyscus* sp., *P. maniculatus*, *P. truei*, *Reithrodontomys megalotis*). MEXICO. Chihuahua: Guacho chic (*Peromyscus maniculatus blandus*).

PEROMYSCOPSYLLA SCOTTI I. FOX, 1939

FIGURES 49-52, 107

Peromyscopsylla scotti I. Fox, Proc. Ent. Soc. Washington, vol. 41, p. 49, figs. 4, 5, 1939; Fleas of the eastern United States, pp. 84, 86, pl. 22, figs.



FIGS. 59-63.—*Peromyscopsylla catatina*: 59, Genal area, ♂; 60, seventh sternum, spermatheca, and bursa copulatrix, ♀; 61, eighth sternum, ♂; 62, immovable process and digitoid of male clasper; 63, distal arm of ninth sternum, ♂. For explanation of symbols see pages 67-68.

111-113, 1940.—JELLISON and GOOD, U. S. Publ. Health Serv., Nat. Inst. Health Bull. 178, p. 123, 1942.

Head.—As in *hesperomys* except: only two rather slender spini-form bristles at anterodorsal angle; genal lobe not extending posteriorly one-half length of lower genal spine; second segment of antenna with fringe of bristles not reaching one-half length of club in male; three-fourths length in female.

Thorax.—Essentially as in *hesperomys* except no erect bristles dorsally on mesonotum.

Abdomen.—Usually with three antepygidial bristles in both sexes (female may have four).

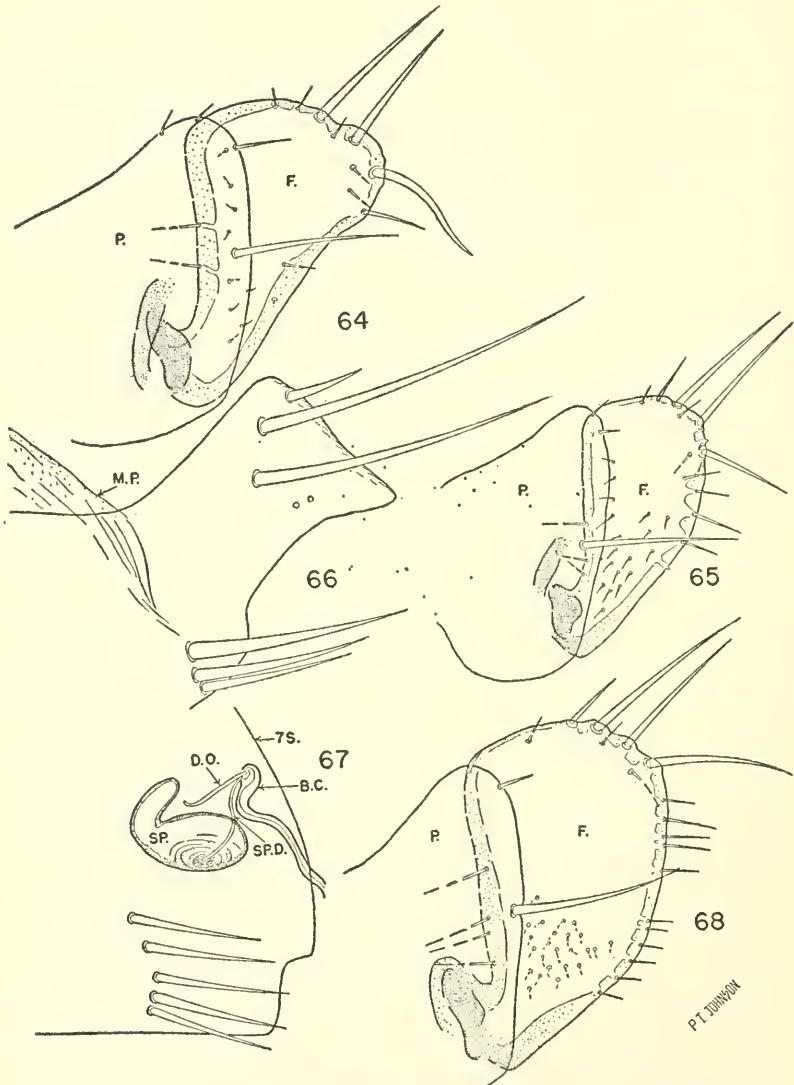
Male.—Eighth tergum with two rows of large bristles mediolaterally, first of one or two bristles, second of three. Eighth sternum (fig. 52) with conspicuous broad deep sinus; upper lobe subtruncate, with three long marginal bristles; lower lobe acute, with one shorter submarginal bristle; membranous process (*M.P.*) reduced to narrow vertical band. Immobile process of clasper (fig. 49, *P.*) with dorsal and ventral margins almost parallel; characteristic bristle on posterior margin inserted below midpoint, this bristle about as long as greatest width of digitoid. Movable finger or digitoid of clasper (*F.*) strongly produced dorsocaudally; twice as long as broad; anterior margin becoming convex; three long bristles posterodorsally; several bristles on dorsal margin, posterior margin, and laterally; one or two thin bristles on anterior margin. Distal arm of ninth sternum (fig. 51) with dorsal (anterior) margin semimembranous proximally; apex acute; ventral (posterior) margin slightly sinuate, in the main very gently convex; bearing 3 or 4 long bristles and 15 to 20 shorter ones, those near apex much shorter than others.

Aedeagus (fig. 107).—Essentially as in *hesperomys* but with crochets (*CR.*) much reduced, represented by short, broad Y-shaped structures, the sagittate or dagger extension lost. Band of inner tube (*B.I.T.*) slightly longer than in *hesperomys*.

Female.—Posterior margin of seventh sternum (fig. 50) with broad lobe, below this fairly straight to ventral margin. Anal stylet three or more times as long as broad; with one long apical and one shorter subapical bristle, and one ventrolateral bristle. (One female examined apparently has two long apical bristles.) Head of spermatheca elongate, oval, as long as, or longer than, tail (fig. 50, *SP.*).

Length.—Male, 2.2-2.4 mm.; female, 2.8 mm.

Holotype.—Female U.S.N.M. No. 52900, from *Peromyscus (leucopus noveboracensis* Fischer?), Dubuque, Iowa.



FIGS. 64-68.—Subspecies of *Peromyscopsylla silvatica*: 64, Immobile process and digitoid of male clasper, *P. s. spectabilis*; 65, same, *P. s. silvatica*; 66, eighth sternum, *P. s. spectabilis*, ♂; 67, seventh sternum, spermatheca, and bursa copulatrix, *P. s. silvatica*, ♀; 68, immobile process and digitoid of male clasper, *P. s. fallax*. For explanation of symbols see pages 67-68.

The range of *P. scotti* is apparently the eastern half of the United States.

RECORDS OF SPECIMENS EXAMINED

UNITED STATES. Kansas: Douglas County (*Peromyscus leucopus*). Maryland: Montgomery County (*Peromyscus* sp.). Massachusetts: Dukes County (*P. leucopus fuscus*). Missouri: Ozark County, "wild mouse." New York: Tompkins County (*Blarina brevicauda*, *Clethrionomys gapperi*, *Peromyscus leucopus*). North Carolina: Halifax County (*Peromyscus* sp.). Oklahoma: Comanche County (*Peromyscus* sp.). South Carolina: Georgetown County (*Peromyscus* sp.).

PEROMYSCOPSYLLA SELENIS (Rothschild, 1906)

FIGURES 53-58, 114

- Ctenopsyllus selenis* ROTHSCHILD, Canadian Ent., vol. 38, p. 322, fig. 43, 1906.
Leptopsylla selenis JORDAN, Nov. Zool., vol. 34, p. 186, 1928.
Ctenopsylla selenis WAGNER, Akad. Nauk S.S.S.R. Zool. Inst., Parazitol. Sbornik (Mag. Parasitol. Mus. Zool. Acad. Sci.), Leningrad, vol. 1, p. 148, pl. 13, fig. 94, 1930.
Ctenopsyllus sclensis (sic) HARKEMA, Ecol. Monogr., vol. 6, p. 209, 1936.
Peromyscopsylla duma TRAUB, Field. Mus. Nat. Hist. Publ., zool. ser., vol. 29, p. 217, 1944 (new synonymy).
Peromyscopsylla selenis TRAUB, Field Mus. Nat. Hist. Publ., zool. ser., vol. 29, p. 217, 1944.—HUBBARD, Fleas of western North America, p. 334, fig. 200, 1947.
Peromyscopsylla duma HUBBARD, Fleas of western North America, pp. 333, 334, fig. 200, a, 1947.
Peromyscopsylla selenis HOLLAND, Canada Dept. Agr. Techn. Bull. No. 70, pp. 175, 178, pl. 40, figs. 331-333, map 42, 1949.

Head.—As in *hesperomys* except: with six long bristles on pre-antennal area (discounting marginals and subdorsals) (fig. 55), not five (fig. 1); upper genal spine the longer, genal lobe (*G.L.*) not extending one-half length of lower genal spine.² Bristles on second antennal segment not reaching beyond second segment of club in both sexes.

Thorax.—As in *hesperomys* except no erect bristles present dorsally on mesonotum.

Abdomen.—Male with three antepygial bristles, female with three or four.

Male.—Eighth tergum mediolaterally with two rows of three or four bristles each, bristles of second row quite long. Eighth sternum (fig. 53) very broad, slightly rounded apically; bearing seven to nine long

² Figure 54 illustrates a male unique in that on one side it bears three genal teeth. This is probably atavistic in origin and is one of two cases observed while studying hundreds of *Peromyscopsylla*. Specimen ex *Clethrionomys* sp., Plumas County, Calif., E. W. Jameson.

caudomarginal bristles and three or four very small ones; with a subapical ventral sinus; proximal to sinus with one or two long bristles; membranous process (*M.P.*) present, narrow, and spiculated on upper portion. Immobile process of clasper (fig. 58, *P.*) with rather narrowly rounded apex, bearing several small bristles; posterior margin with characteristic long, stout median bristle. Digitoid or movable finger of clasper (*F.*) broadest above middle, with posterior margin strongly rounded, anterior margin fairly straight; three long and several shorter caudomarginal bristles on dorsal half; two or three slender bristles on anterior margin; several small hairs on mesal and lateral surfaces. Distal arm of ninth sternum (fig. 57) with anterior (dorsal) portion semimembranous from base to near apex; apex truncate, bearing several very short bristles; three or four long, stout bristles near midpoint of markedly convex portion of posterior (ventral) margin; with a fringe of smaller marginal and submarginal proximal bristles.

Aedeagus (fig. 114).—Distolateral lobe (*DL.L.*) shaped like an old-fashioned bonnet; central thickening (*C.TH.*) represented by an irregular sclerotized area. Apex of sclerotized inner tube (*A.S.I.*) with its dorsal spur extending caudad, not dorsad; associated with a semimembranous, filamentous structure. Crochets (*CR.*) obtuse, with base fairly well developed, quite broad and more than half as long as spatulate or duckbill-shaped extension.

Female.—Posterior margin of seventh sternum (fig. 56) with margin of upper lobe fairly straight; very shallow sinus; slightly convex or straight below sinus to ventral margin. Anal stylet three times as long as broad, with one long apical bristle and one somewhat shorter subapical ventral bristle. Spermatheca (fig. 56, *SP.*) with head rather evenly oval; tail as long as head.

Length.—Male, 2.0–2.2 mm.; female, 2.45–2.9 mm.

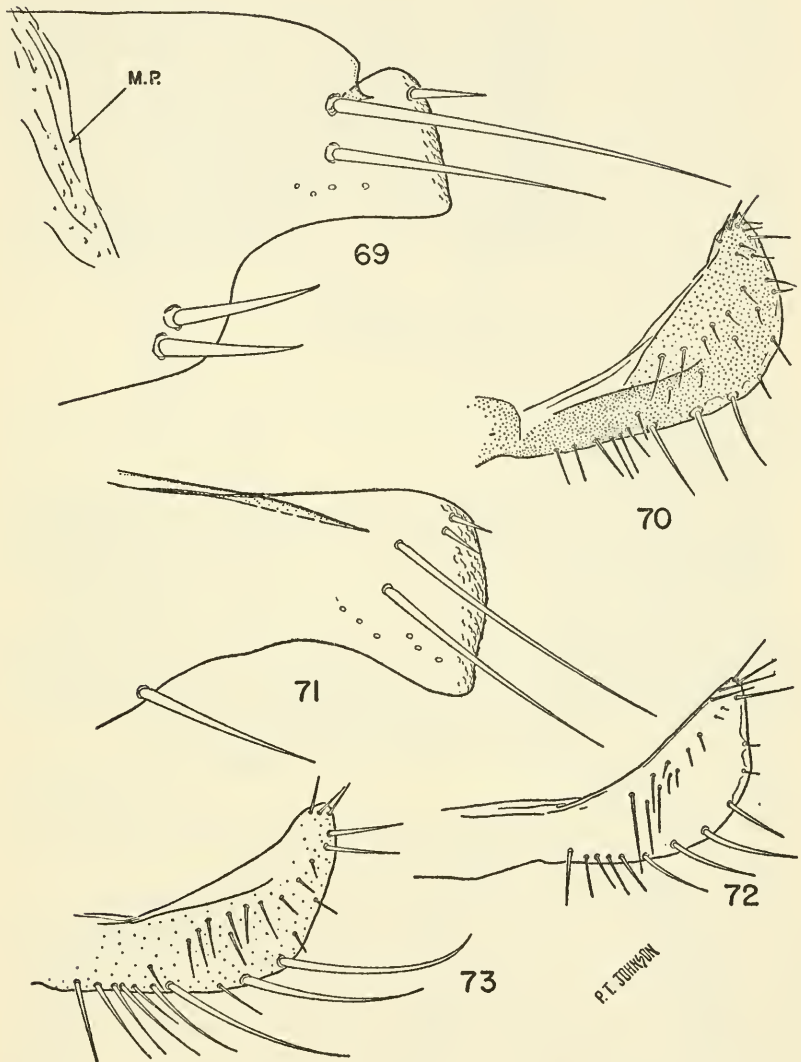
No types designated. Cotype hosts: *Peromyscus canadianus* (?), *Microtus drummondi*, and *Evotomys* (= *Clethrionomys*) *gapperi*, from Horse Creek, upper Columbia Valley, British Columbia; Kick-inng Horse Canyon, British Columbia; Red Deer, Alberta.

The range of this flea is the western United States and Canada, east into the Rockies, and south to northern California.

RECORDS OF SPECIMENS EXAMINED

CANADA. Alberta (*Microtus* sp.); British Columbia (*Clethrionomys* sp., *Microtus longicaudus* (= *M. mordax*), *Peromyscus* sp.).

UNITED STATES. California: Fresno County (*Microtus longicaudus sierrae*); Marin County (*M. californicus*); Plumas County (*Clethrionomys californicus*,



FIGS. 69-73.—Subspecies of *Peromyscopsylla silvatica*: 69, Eighth sternum, *P. s. fallax*, ♂; 70, distal arm of ninth sternum, *P. s. fallax*, ♂; 71, eighth sternum, *P. s. silvatica*, ♂; 72, distal arm of ninth sternum, *P. s. silvatica*, ♂; 73, same, *P. s. spectabilis*, ♂. For explanation of symbols see pages 67-68.

Microtus sp., *M. californicus*, *M. longicaudus*, *M. montanus*, *Peromyscus maniculatus*). Colorado: El Paso County (*Phenacomys* sp.). Idaho: Benewah County (*Microtus montanus nanus*); Latah County (*Microtus* sp.); Lemhi County (*Phenacomys* sp.). Montana: Ravalli County (*Microtus longicaudus* (= *M. mordax*)). New Mexico: Catron County (*Microtus* sp.); Sandoval County (*M. pennsylvanicus aztecus*); San Miguel County (*M. pennsylvanicus*); Santa Fe County (*Neotoma* sp.). Oregon: Benton County (*Microtus* sp.); Crater Lake National Park (*M. longicaudus*); Estacada (*Clethrionomys californicus obscurus*); Klamath County (*C. c. mazama*); Linnton (*Mustela* sp.). Utah: Cache County (*Microtus* sp., *Peromyscus* sp.); Iron County (*Microtus longicaudus*); Salt Lake County (*M. montanus*); San Pete County (*M. longicaudus*, *Peromyscus maniculatus*); Utah County (*Microtus* sp.). Washington: Spokane County (*Microtus* sp.).

PEROMYSCOPSYLLA CATATINA (Jordan, 1928)

FIGURES 59-63, III, 112

Leptopsylla catatina JORDAN, Nov. Zool., vol. 34, p. 186, fig. 10, 1928; vol. 35, p. 171, fig. 6, 1929.

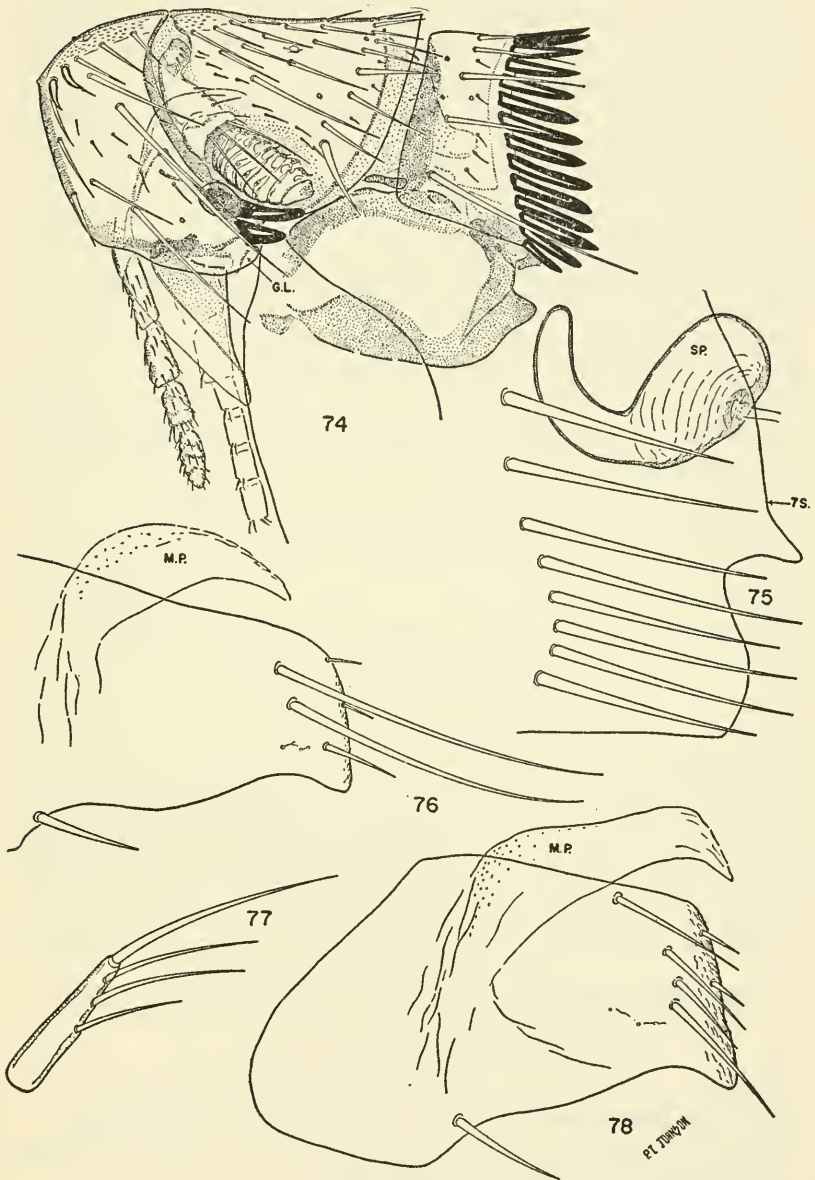
Peromyscopsylla catatina I. FOX, Fleas of the eastern United States, pp. 84, 87, pl. 22, figs. 110, 114, 115, 1940.—JELLISON and GOOD, U. S. Publ. Health Serv., Nat. Inst. Health Bull. 178, p. 121, 1942.—TRAUB, Field Mus. Nat. Hist. Publ., zool. ser., vol. 29, p. 218, 1944.—HOLLAND, Canada Dept. Agr. Techn. Bull. No. 70, pp. 175, 176, pl. 40, figs. 325-327, map 42, 1949.

Head.—Mostly as in *hesperomys* except: upper genal spine the longer (fig. 59); genal lobe (*G.L.*) very short, not one-half length of lower genal spine; second antennal segment with apical row of bristles not reaching beyond second segment of club in both sexes.

Thorax.—As in *hesperomys* except dorsal margin of mesonotum lacking erect bristles.

Abdomen.—With three antepygidial bristles in male (rarely two); female usually with four, sometimes three.

Male.—Eighth tergum with two rows of mediolateral bristles, first of two or three rather short bristles, second of two or three very long bristles. Eighth sternum (fig. 61) with apex broadly rounded, lacking sinus; bearing four subapical bristles, two of these very short; membranous process (*M.P.*) filamentous, prominent. Immobile process of clasper (fig. 62, *P.*) with characteristic bristle on posterior margin long. Digitoid or movable finger of clasper (*F.*) proximally somewhat narrowed; posterior margin evenly convex; distal half of anterior margin convex: with three long bristles on upper half of posterior margin; two thin bristles on anterior margin; mesal and lateral surfaces with several short bristles. Distal arm of ninth sternum (fig. 63) narrow, with subrounded apex; distal half sclerotized and with a heavily sclerotized band running diagonally across from anterior



FIGS. 74-78.—*Peromyscopsylla hamifer hamifer* and *P. h. vigens*: 74, Head and prothorax, *P. h. hamifer*, ♂; 75, seventh sternum and spermatheca, *P. h. hamifer*, ♀; 76, eighth sternum, *P. h. vigens*, ♂; 77, anal stylet, *P. h. hamifer*, ♀; 78, eighth sternum, *P. h. hamifer*, ♂. For explanation of symbols see pages 67-68.

(dorsal) margin of apex to posterior (ventral) margin; basal half of dorsal margin semimembranous; with four or five long ventromarginal bristles and many smaller marginal and lateral bristles occurring both on the sclerotized and membranous parts.

Aedeagus (figs. 111, 112).—Distolateral lobe (*DL.L.*) broader at base than at rounded apex, shaped like a broad, blunt arrow; longer than sclerotized inner tube. Central thickening (*C.TH.*) at proximo-ventral angle. Sclerotized inner tube (*S.I.T.*) with a conspicuous long, subapical, dorsal spur (*A.I.T.*), in addition to the typical short spur near midpoint. Lateral lobes (*L.L.*) relatively narrow. Crochets (*CR.*) obtuse; proximal portion broader than subacute apical portion. Accessory lateral lobes (*A.L.L.*) relatively broad.

Female.—Posterior margin of seventh sternum (fig. 60) with small triangular upper lobe, below this a small, shallow sinus, remainder of caudal margin straight. Spermatheca (fig. 60, *SP.*) head about same length as tail; tail somewhat narrower at insertion of head than is usual in genus.

Length.—Male, 1.9–2.5 mm.; female, 2.5–2.8 mm.

Holotype.—Female from *Didelphis virginianus* Kerr, Rolling Rock Club, Ligonier, Pa.

The range of *catatina* is the eastern United States and Canada.

RECORDS OF SPECIMENS EXAMINED

CANADA. Labrador (*Clethrionomys gapperi proteus*, "gray vole"); Quebec (*C. g. proteus*).

UNITED STATES. Maine: Piscataquis County (*Clethrionomys gapperi ochraceus*). Massachusetts: Worcester County (*C. gapperi*). New Hampshire: Carroll County (*C. g. ochraceus*). New York: Greene County (*C. gapperi*); Hubbardsville (*C. g. gapperi*); Tompkins County (*Blarina brevicauda*, *Clethrionomys gapperi gapperi*). Pennsylvania: Pike County (*Blarina brevicauda*); Wayne County (*Clethrionomys gapperi*, *Microtus chrotorrhinus*). Tennessee: Great Smoky Mountains National Park (*Peromyscus maniculatus nubiterrae*).

PEROMYSCOPSYLLA SILVATICA SILVATICA (Meinert, 1896)

FIGURES 65, 67, 71, 72, 113

Typhlopsylla silvatica MEINERT, Ent. Medd., vol. 5, pp. 184, 192, 1896.

Ctenopsyllus silvatica ROTHSCHILD, Ent. Month. Mag., vol. 45, p. 184, 1909.

Leptopsylla silvatica JORDAN, Nov. Zool., vol. 38, pp. 257, 259, 263, fig. 13, 1932; Mitt. Naturw. Inst. Sofia, vol. 5, p. 147, 1932.

Head.—As in *hesperomys* but upper genal spine the longer and genal lobe very short; bristles on apex of second antennal segment less than one-half length of club in male, three-fourths length in female; postantennal area with four regular rows of bristles.

Thorax.—As in *hesperomys*, except no erect dorsal bristles on mesonotum.

Abdomen.—Anterior row of bristles on terga quite long, even on sixth and seventh terga in both male and female. Male with three antepygidial bristles, female with five.

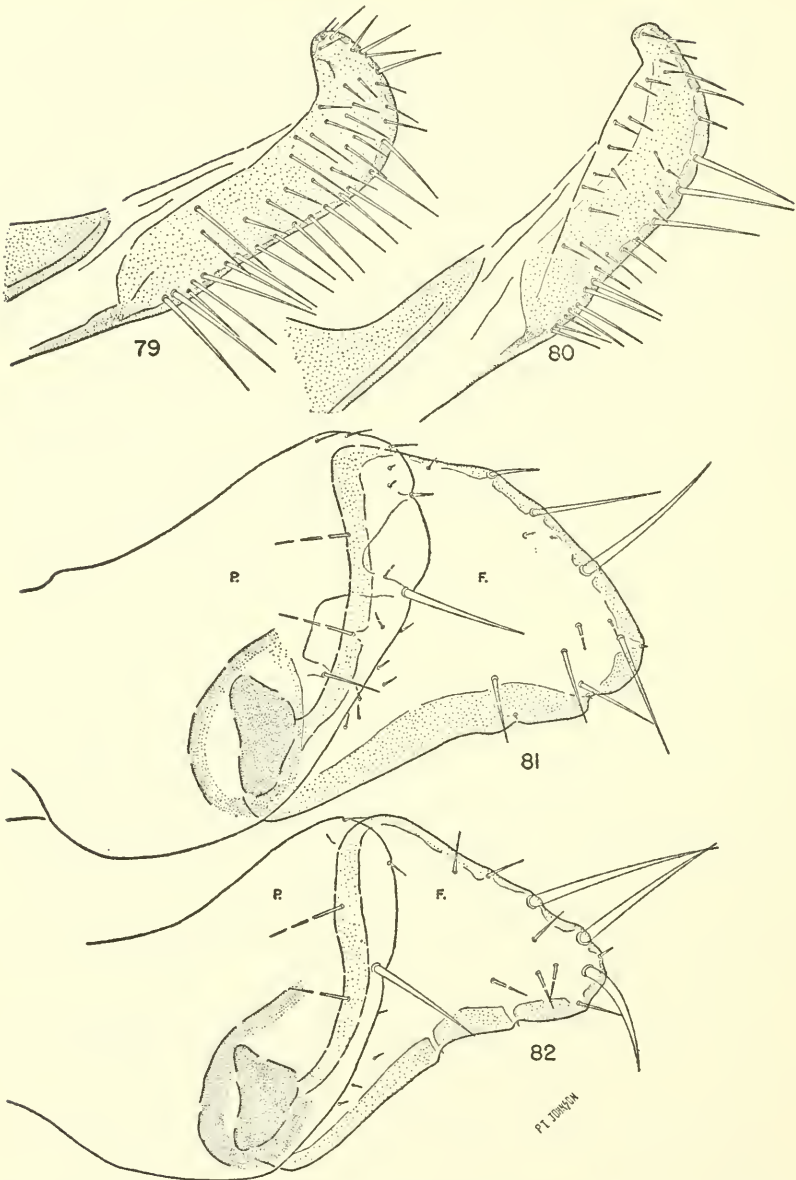
Male.—Tergum 8 posterior to spiracle with bristles arranged 2-3, those of posterior row the longer. Eighth sternum (fig. 71) in shape much as *h. hamifer*, but with dorsal extension or fold from base to near apex dorsally; with two very long lateral subapical bristles and two small light bristles at dorsal angle of apex; one or two stout bristles basally. Characteristic bristle on posterior margin of immovable process of clasper (fig. 65, *P.*) stout and longer than width of movable finger. Movable finger or digitoid of clasper (*F.*) broadest at apex with straight anterior margin, convex posterior margin; dorsal margin slightly convex; three large bristles posterodorsally. Distal arm of ninth sternum (fig. 72) with semimembranous dorsal (anterior) subapical margin; posterior (ventral) margin strongly rounded, bearing several medium-sized bristles and basally some small bristles; laterally with scattered row of thin bristles; apex with several small thin bristles.

Aedeagus (fig. 113).—Aedeagal end chamber definitely broader than long, due to the marked convexity of lateral lobes (*L.L.*). Distolateral lobe (*DL.L.*) relatively small in proportion to width of end chamber. With a well-developed central thickening (*C.TH.*). Sclerotized inner tube (*S.I.T.*) lacking a ventral sclerotization. Armature of inner tube (*A.I.T.*) consisting of a small dorsomedian spur. Apex of sclerotized inner tube (*A.S.I.*) not expanded. Crochets (*CR.*) with usual sagittate element, short and blunt, its base relatively long, in addition, with weakly sclerotized outlines (*CR.O.*) indicating that true crochet is subovate and about twice as long as broad. The aedeagus is apparently similar in all subspecies of *silvatica*.

Female.—Spermatheca (fig. 67, *SP.*) as in *hesperomys*; posterior margin of seventh sternum (fig. 67) with a shallow but distinct ventral sinus. Anal stylet $3\frac{1}{2}$ times as long as wide, with one long apical bristle and two shorter subapical ones.

Type.—From Frijsenborg, Denmark, from mouse nest in tree stump in woods.

The range of *s. silvatica* is apparently most of Europe and Asia, except the British Isles and European Alps, where it is replaced by *s. spectabilis* and *s. fallax* respectively.



FIGS. 79-82.—*Peromyscopsylla hamifer vigenis* and *P. h. hamifer*: 79, Distal arm of ninth sternum, *P. h. vigenis*, ♂; 80, same, *P. h. hamifer*, ♂; 81, immovable process and digitoid of male clasper, *P. h. vigenis*; 82, same, *P. h. hamifer*. For explanation of symbols see pages 67-68.

RECORD OF SPECIMENS EXAMINED

Two males and two females, from *Lemmus lemmus*, Punta (Gunta?), Lapland, Aug. 21, 1930.

PEROMYSCOPSYLLA SILVATICA SPECTABILIS (Rothschild, 1898)

FIGURES 64, 66, 73

Typhlopsylla spectabilis ROTHSCHILD, Ent. Rec., vol. 10, p. 250, 1898.

Ctenopsylla spectabilis WAGNER, Hor. Soc. Ent. Rossicae, vol. 36, p. 151, 1903.—

ROTHSCHILD, Ent. Month. Mag., vol. 45, p. 184, pl. 2, fig. 2, 1909.

Leptopsylla spectabilis WATERSTON, Ent. Month. Mag., vol. 50, p. 165, 1914.—

ROTHSCHILD, Ent. Month. Mag., vol. 51, p. 82, pl. 13, fig. 81, 1915.

Ctenopsylla silvatica WAGNER, Akad. Nauk S.S.S.R. Zool. Inst., Parazitol. Sbornik (Mag. Parasitol. Mus. Zool. Acad. Sci.), Leningrad, vol. 1, p. 147, pl. 13, fig. 91, 1930 (sinks *spectabilis*).

Leptopsylla spectabilis JORDAN, Nov. Zool., vol. 38, p. 257, 1932.

Peromyscopsylla silvatica spectabilis HOPKINS, Journ. Washington Acad. Sci., vol. 42, No. 11, p. 364, 1952.

Head, thorax, and abdomen.—As in *s. silvatica*.

Male.—Sternum 8 (fig. 66) with truncate apex bearing diagonal row of three bristles, one at apex much the shortest; row of three or four close-set bristles at base of shallow ventral sinus. Movable finger or digitoid of clasper (fig. 64, *F.*) more clavate than in other subspecies due to dorsal expansion and proximal constriction of caudal margin; bearing at dorsocaudal angle three long marginal bristles, lowest slightly sinuate in specimen examined; a few smaller bristles on dorsal and posterior margins; several small mesal and lateral bristles other than marginals. Distal arm of ninth sternum (fig. 73) with posterior (ventral) margin quite convex, bearing three or four long bristles and several shorter ones; apex subacute with about three to four small bristles; some small lateral bristles; the basal half of anterior (dorsal) margin semimembranous.

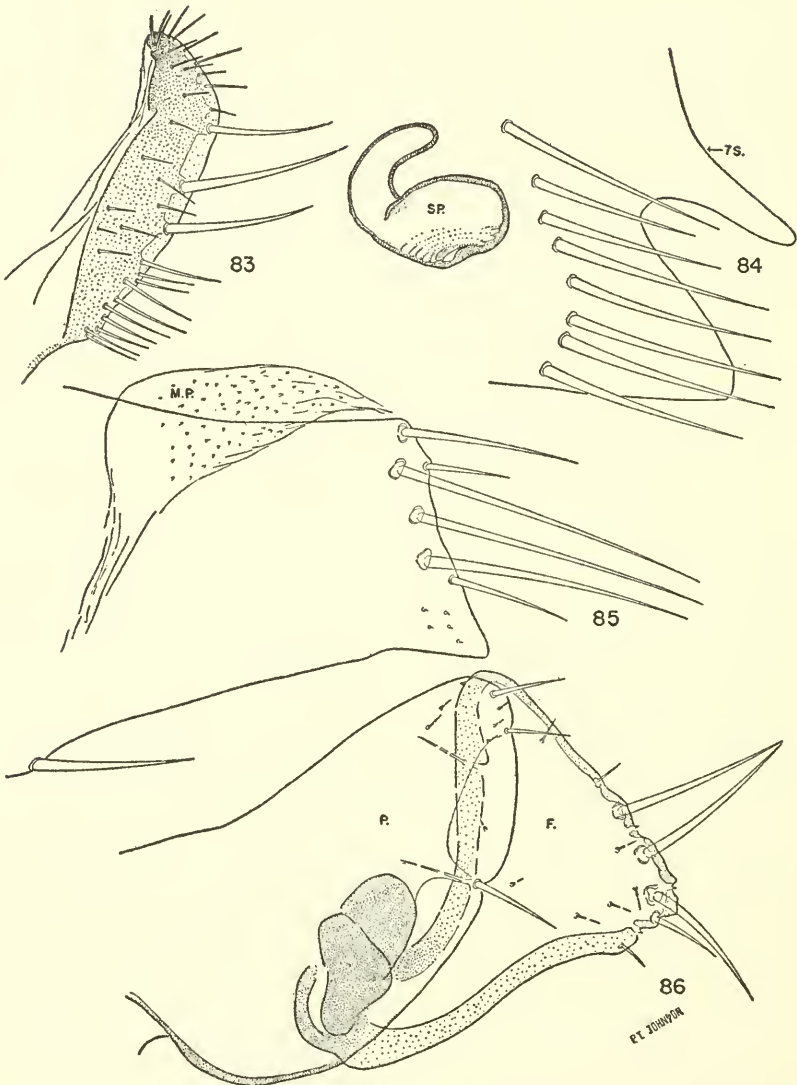
Details of female modified segments indistinguishable from *s. silvatica*.

Types.—From *Clethrionomys* (= *Hypudaeus*) *glareolus*; Scotland, North Berwick.

The range of *s. spectabilis* is the British Isles.

RECORDS OF SPECIMENS EXAMINED

One male and two females from *Microtus agrestis*, Bagley Wood, England, October 1926, C. E. Eaton. One male and three females from *Microtus* sp., Bagley Wood, near Oxford, England, 1928.



FIGS. 83-86.—*Peromyscopsylla longiloba*: 83, Distal arm of ninth sternum, ♂; 84, seventh sternum and spermatheca, ♀; 85, eighth sternum, ♂; 86, immovable process and digitoid of male clasper. For explanation of symbols see pages 67-68.

PEROMYSCOPSYLLA SILVATICA FALLAX (Rothschild, 1909)

FIGURES 68-70

- Ctenopsyllus fallax* ROTHSCHILD, Ent. Month. Mag., vol. 45, p. 185, pl. 2, fig. 1, 1909.
- Leptopsylla fallax* JORDAN and ROTHSCHILD, Ectoparasites, vol. 1, p. 113, 1920.
- Leptopsylla fallax* JORDAN and ROTHSCHILD, Ectoparasites, vol. 1, p. 289, 1923.
- Ctenopsylla fallax* WAGNER, Akad. Nauk S.S.S.R. Zool. Inst., Parazitol. Sbornik (Mag. Parasitol. Mus. Zool. Acad. Sci.), Leningrad, vol. 1, p. 148, pl. 13, figs. 92, 93, 1930.
- Leptopsylla fallax* JORDAN, Nov. Zool., vol. 36, pp. 227, 231, 1931; vol. 38, p. 257, 1932.
- Ctenopsyllus fallax* WAGNER, Tierwelt Mitteleuropas, vol. 6, Abt. 17, p. 16, fig. 60, 1936; Bronn's Kl. Ordnung. Tierreichs, vol. 5, Abt. 3, Buch 13, Teil f, figs. 19 (p. 19), 86 (p. 85).
- Peromyscopsylla silvatica fallax* HOPKINS, Journ. Washington Acad. Sci., vol. 42, No. 11, p. 364, 1952.

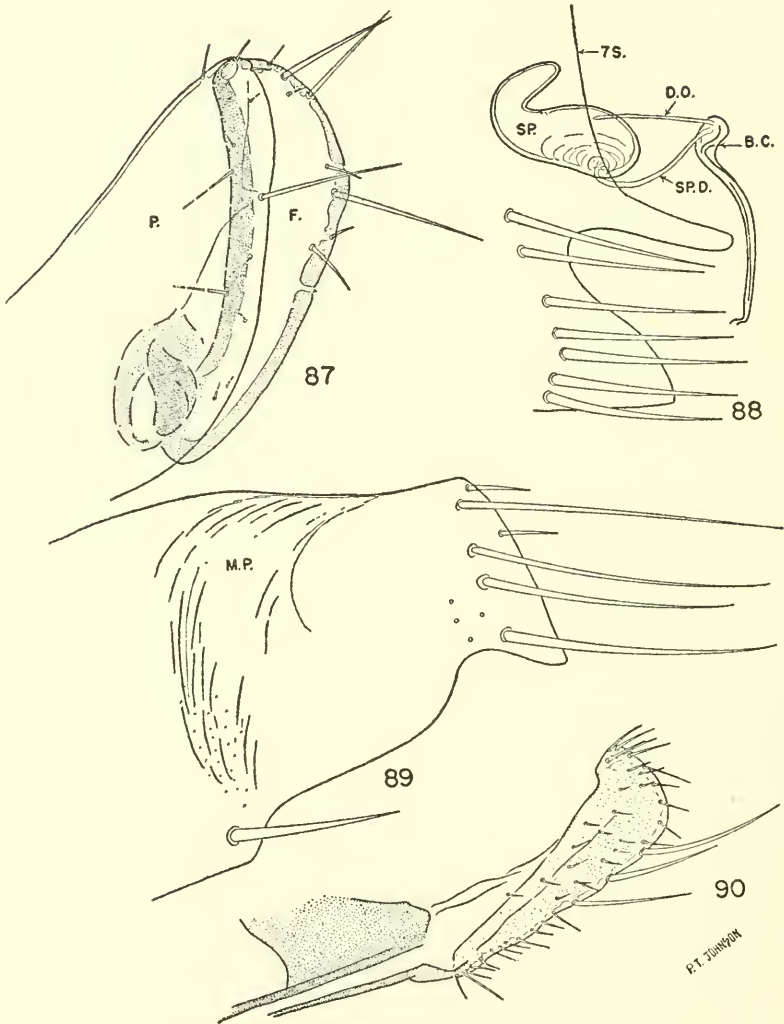
Head, thorax, and abdomen.—As in *s. silvatica*. Differs from other members of the species in details of the modified segments of the male. Digitoid or movable finger of clasper (fig. 68, *F.*) with rounded posterior margin, widest at dorsal portion; dorsal margin somewhat convex; three long bristles at posterodorsal angle, several small bristles on dorsal and posterior margins; lower half with numerous small mesal bristles. Eighth sternum (fig. 69) with dorsal fold subapical and short; posterior margin straight; ventral margin gently concave to near insertion of two short, very stout ventral bristles; one short dorsomarginal bristle and two long subapical bristles. Distal arm of ninth sternum (fig. 70) with strongly rounded, upswept, posterior (ventral) margin; apex acute; anterior (dorsal) margin nearly straight; relatively quite broad subapically; a few short apical and subapical marginal bristles; posterior (ventral) margin with two to three medium-sized bristles proximal to upswing, and basally with a few smaller bristles; laterally, apical half with several small bristles. Details of female modified segments indistinguishable from *s. silvatica*.

Type.—From *Microtus arvalis* Campfer, Upper Engadine, Switzerland.

The range of this subspecies is the European Alps.

RECORDS OF SPECIMENS EXAMINED

Female from *Apodemus sylvaticus*, pine tree in Charrade, France, Sept. 13, 1935, M. Rothschild. Male from *Clethrionomys* (= *Evothomys*) *glareolus*, S[an]. Martini, Dolomites, Italy, Sept. 15, 1939, K. Jordan.



FIGS. 87-90.—*Peromyscopsylla bidentata*: 87, Immoveable process and digitoid of male clasper; 88, seventh sternum, spermatheca, and bursa copulatrix, ♀; 89, eighth sternum, ♂; 90, distal arm of ninth sternum, ♂. For explanation of symbols see pages 67-68.

PEROMYSCOPSYLLA HAMIFER HAMIFER (Rothschild, 1906)

FIGURES 74, 75, 77, 78, 80, 82, 116, 117

- Ctenopsyllus hamifer* ROTHSCHILD, Canadian Ent., vol. 38, p. 324, fig. 44, 1906.
Ctenopsylla hamifer WAGNER, Akad. Nauk S.S.S.R. Zool. Inst., Parazitol. Sbornik (Mag. Parasitol. Mus. Zool. Acad. Sci.), Leningrad, vol. 1, p. 148, 1930.
Leptopsylla hamifer COLLINS, in Stiles and Baker, U. S. Publ. Health Serv., Nat. Inst. Health Bull. 163, p. 1019, 1934.
Leptopsylla hamifer hamifer JORDAN, Nov. Zool., vol. 40, p. 265, 1937; vol. 41, p. 319, fig. 271, 1939.
Peromyscopsylla hamifer hamifer JELLISON and GOOD, U. S. Publ. Health Serv., Nat. Inst. Health Bull. 178, pp. 121, 122, 1942.—HUBBARD, Fleas of western North America, pp. 336, 337, fig. 213, 1947.
Peromyscopsylla hamifer markworthi HUBBARD, Fleas of western North America, pp. 336, 337, fig. 203, 1947.
Peromyscopsylla hamifer hamifer HOLLAND, Canada Dept. Agr. Techn. Bull. No. 70, p. 176, pl. 40, figs. 328–330, map 42, 1949.—HOPKINS, Ann. Mag. Nat. Hist., ser. 12, vol. 4, pp. 542, 543, 1951 (sinks *markworthi*).

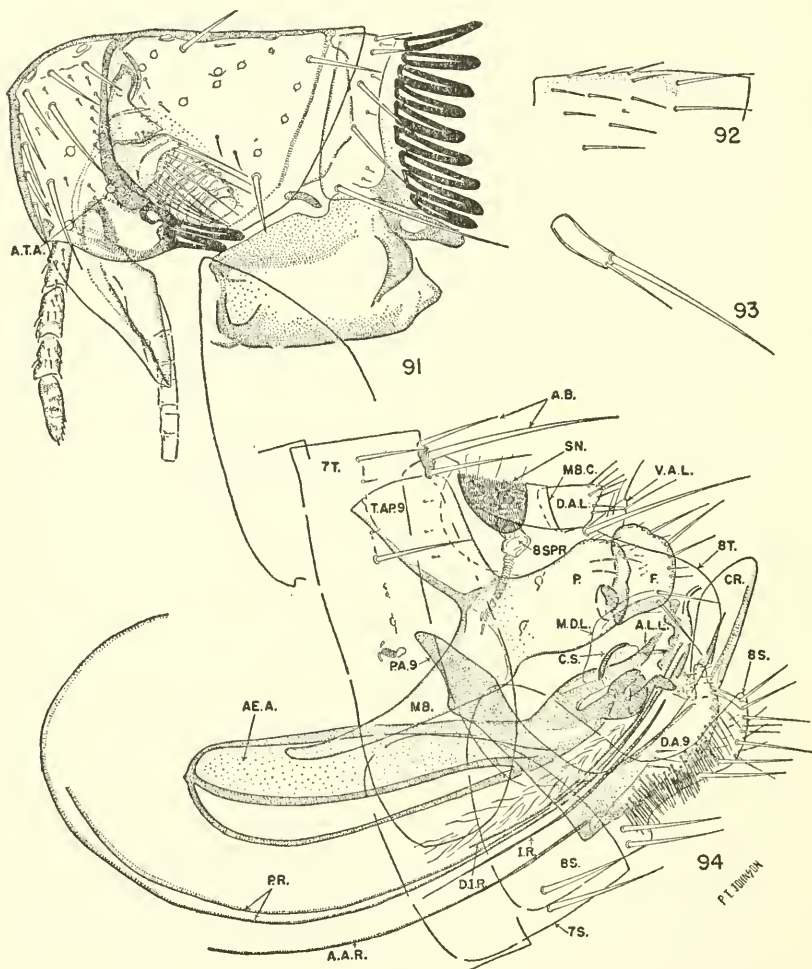
Head (fig. 74).—In general outline, much as *hesperomys*. Differs in that there are three, not two, bristles in subdorsal row between frontal angle and antennal groove; two rather slender spiniforms at frontal angle, not three or four. Upper genal spine the longer; genal process hidden behind genal ctenidium; genal lobe (*G.L.*) much reduced, less than one-half length of lower genal spine. Apical bristles on second antennal segment three-fourths as long as club in male, to apex of club in female. Postantennal area with four regular rows of bristles.

Thorax.—As in *hesperomys*, except mesonotum with three rows of bristles plus some scattered anterior bristles, and no erect bristles dorsally (fig. 23).

Abdomen.—As in *hesperomys*, except posterior row of bristles in male may extend well below the spiracle on typical terga; three antepygidial bristles in male, five or six in female (rarely four).

Male.—Portion of eighth tergum posterior to spiracle with two rows of bristles, first row of three medium-sized bristles, posterior of three much longer bristles. Eighth sternum (fig. 78) with truncate apex; ventrocaudal angle subacuminate; ventral margin irregularly concave; apex bearing four long submarginal bristles and two very small marginal bristles; lower lobe virtually absent, this area with one long marginal bristle; membranous process (*M.P.*) well defined, apically acute, spiculated. Immobile process of clasper (fig. 82, *P.*) with rounded apex; posterior margin slightly convex with indentation above middle at insertion of characteristic bristle which is about one-

half as long as greatest width of movable finger or digitoid; ventral margin smoothly and shallowly rounded to region where it joins the manubrium. (One male from Lincoln, Maine, shows this area



FIGS. 91-94.—*Peromyscopsylla tikhomirovae*: 91, Head and prothorax, ♂; 92, dorsal portion of mesonotum, ♂; 93, anal stylet, ♀; 94, modified segments, ♂. For explanation of symbols see pages 67-68.

slightly angled, but not definitely so.) Movable process of clasper (*F.*) roughly triangular in shape, with apex of triangle being ventral; anterior and posterior margins proximally concave; the anterior and posterior dorsal angles subrounded; dorsal margin from slightly con-

cave to straight; three large bristles near dorsocaudal angle, most ventral may be sinuate; posterior margin with two notches containing minute bristles; anterior margin with two to four thin, long bristles. Distal arm of ninth sternum (fig. 80) rather broad; with small truncate apex and convex posterior (ventral) margin on which are some medium-sized marginal bristles; three longer marginal bristles; several smaller bristles laterally near apex and on anterior (dorsal) margin on semimembranous portion; and some small lateral bristles.

Aedeagus (fig. 117).—Aedeagal end chamber exceptionally long and broad. Lateral lobes (*L.L.*) with a conspicuous apical and dorso-apical roughly triangular, dense patch of microverrucae or large spicules. Median dorsal lobe (*M.D.L.*) relatively well sclerotized. Accessory lateral lobe (*A.L.L.*) acuminate. Distolateral lobes (*DL.L.*) very large, with an apical lateral, more heavily sclerotized portion; central thickening (*C.TH.*) conspicuous. Fulcrum extending from *S.I.T.* to *DL.L.*, long and narrow. Crochets (*CR.*) somewhat reduced, shaped like a spearhead; not as long as inner tube. Sclerotized inner tube (*S.I.T.*) bearing a very conspicuous huge keellike lateral sclerotization (*L.S.I.*). Armature of inner tube (*A.I.T.*) consisting of a thick, median, dorsal spur.

Female.—Posterior margin of seventh sternum (fig. 75) with a dorsal lobe which may be extremely small and triangular or much longer with narrowly rounded apex; below this gently convex to ventral margin. Row of five or six short bristles on eighth tergum, above spiracle. Anal stylet (fig. 77) about $5\frac{1}{2}$ times as long as broad, bearing one long apical bristle and two or three shorter ventromarginal bristles. Head of spermatheca (fig. 75, *SP.*) two times as wide as tail; tail about as long as head.

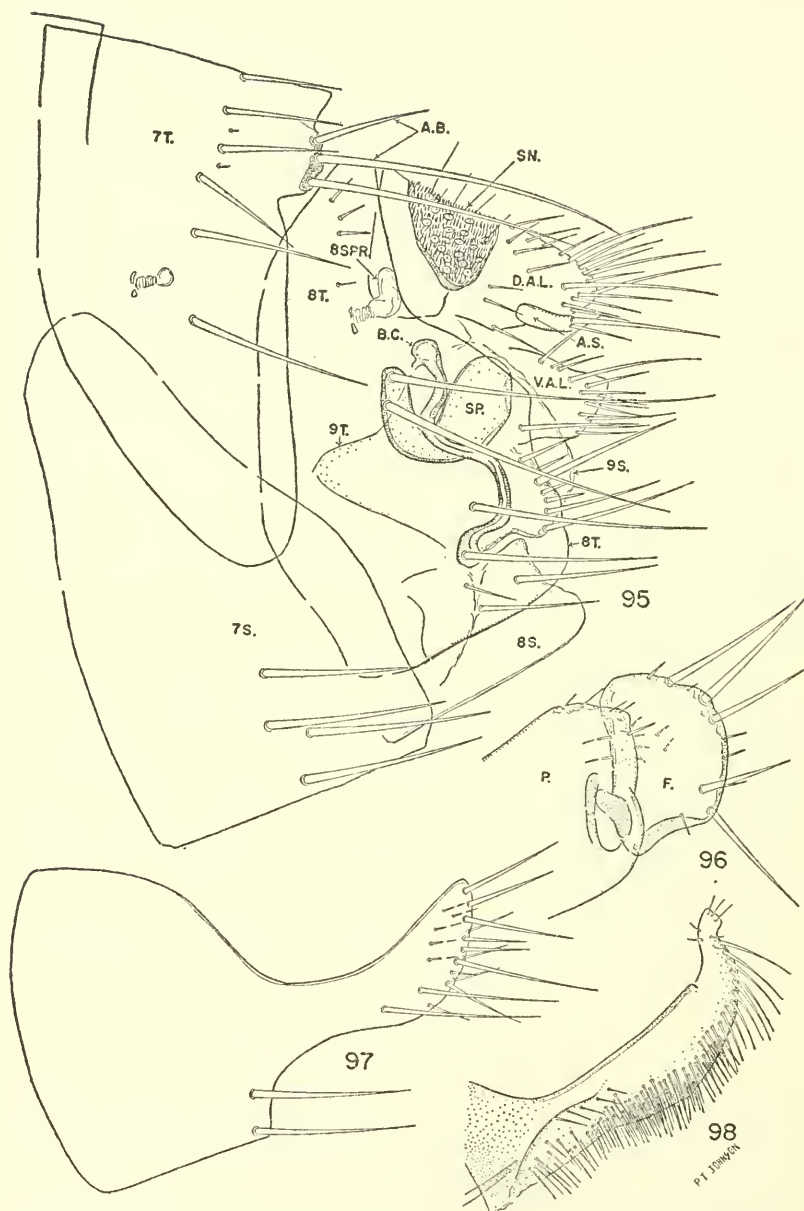
Length.—Male, 2.2–2.8 mm.; female, 2.9–3.3 mm.

Holotype.—Male, from *Mustela* sp., “Blackfalls” [Blackfalds], Alberta.

RECORDS OF SPECIMENS EXAMINED

CANADA. Alberta (*Mustela erminea*); Labrador (*Microtus pennsylvanicus*, *Clethrionomys gapperi proteus*); Keewatin, Northwest Territories (*Microtus pennsylvanicus*); Ontario (*Microtus* sp., *M. p. pennsylvanicus*, *Mustela c. cicognanii*); Quebec (*Microtus pennsylvanicus labradorius*, *M. pennsylvanicus*, *Clethrionomys gapperi proteus*).

UNITED STATES. Maine: Penobscot County, “mink.” Maryland: Montgomery County (*Microtus* sp.); Prince Georges County (*Peromyscus* sp.). New Hampshire: Carroll County (*Microtus pennsylvanicus pennsylvanicus*). Virginia: Fairfax County (*Microtus* sp.). Wisconsin: Bayfield County (*Microtus* sp.).



FIGS. 95-98.—*Peromyscopsylla tikhomirovae*: 95, Modified segments, ♀; 96, immovable process and digitoid of male clasper; 97, eighth sternum, ♂; 98, distal arm of ninth sternum, ♂. For explanation of symbols see pages 67-68.

PEROMYSCOPSYLLA HAMIFER VIGENS (Jordan, 1937)

FIGURES 76, 79, 81, 118

Leptopsylla hamifer vigens JORDAN, Nov. Zool., vol. 40, p. 265, figs. 47, 48, 1937.
Peromyscopsylla hamifer vigens JELLISON and GOOD, U. S. Publ. Health Serv.,
 Nat. Inst. Health Bull. 178, p. 122, 1942.—HUBBARD, Fleas of western North
 America, pp. 336, 337, fig. 204, 1947.

Head, thorax, and abdomen.—As in *hamifer hamifer*. Differs in the male in details of the modified abdominal segments. The ventral margin of the immovable process of the clasper (fig. 81, *P.*) is sharply angled at juncture with the manubrium, not evenly curved as in *h. hamifer*; the dorsal margin of movable finger or digitoid of clasper (*F.*) is usually markedly convex, not straight or slightly concave; dorsal lobe of sternum 8 (fig. 76) narrower than in *h. hamifer*, bearing an oblique row of three submarginal bristles, the upper two very long, the most ventral short, with two small marginal bristles nearer dorsal than ventral angle of posterior margin. Distal arm of sternum 9 (fig. 79) with more sharply upturned apical portion, apex not truncate; no small bristles present on semimembranous portion, which is not as expanded as in *h. hamifer*; lateral sclerotized surface with many more and longer bristles than in *h. hamifer*; none of posterior (ventral) marginal bristles elongate.

Aedeagus (fig. 118).—Differs from that of *h. hamifer* in that the patch of microverrucae or spicules is larger, extending ventrally to level of base of crochets; with striations extending from fulcrum to upper portion of patch of spicules (striae absent in *h. hamifer*). Fulcrum (*FM.*) with a distinct, relatively well-sclerotized process (*FM.P.*) which arises from fulcrum at level of apex of inner tube (*S.I.T.*) and extends to near apex of *DL.L.*, the process variable in position.

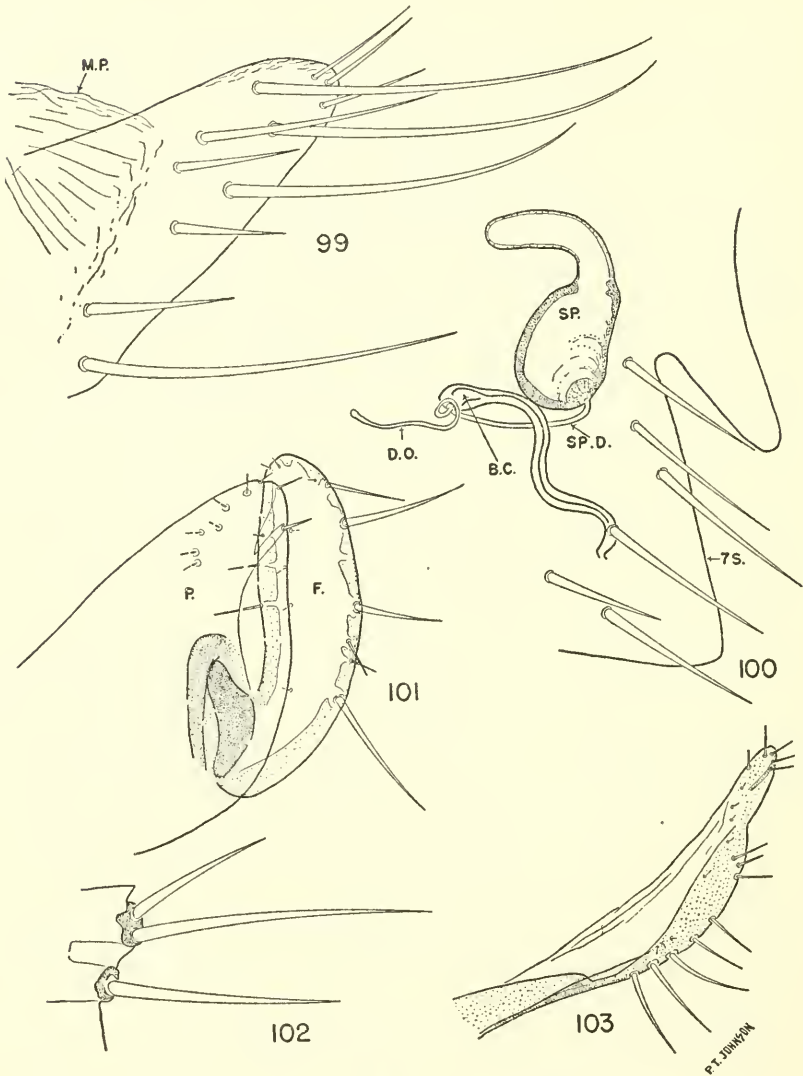
The females of *h. hamifer* and *h. vigens* are not morphologically distinguishable, and must be determined only with associated males or by geographic location.

Length.—Male, 2.3–2.6 mm.; female, 2.8–3.0 mm.

Type series.—From *Microtus*, Ravalli County, Mont.

RECORDS OF SPECIMENS EXAMINED

UNITED STATES. Colorado: Clear Creek County (*Microtus pennsylvanicus*); Estes Park (*Microtus* sp.). New Mexico: Catron County (*Microtus* sp.); San Miguel County (*M. pennsylvanicus*); Sandoval County (*M. pennsylvanicus aztecus*). Utah: Cache County (*Microtus* sp.); Salt Lake County (*M. montanus*). Wyoming: Yellowstone National Park (*Microtus* sp.).



FIGS. 99-103.—*Peromyscopsylla himalaica*: 99, Eighth sternum, ♂; 100, seventh sternum, spermatheca, and bursa copulatrix, ♀; 101, immovable process and digitoid of male clasper; 102, pedestal of antepygidial bristles, ♀; 103, distal arm of ninth sternum, ♂. For explanation of symbols see pages 67-68.

PEROMYSCOPSYLLA HAMIFER CUNEATA, new subspecies

FIGURES 124-131

Types.—From Korea: Holotype male, allotype female, from *Apodemus agrarius*, Chip'or-i, Oct. 16, 1952; two paratype females from *Microtus fortis pelliceus*, Oct. 23, 1952; one paratype female, Ch'ongyang-ni, Oct. 2, 1952; one paratype female, Oct. 14, 1952. All collected by Field Unit of the Commission on Hemorrhagic Fever, United States Army. Holotype and allotype deposited in the collections of the U. S. National Museum. Paratypes in the collection of Robert Traub.

Diagnosis.—Differs from other subspecies of *hamifer* in that the bristles on the second antennal segment are one-half the length of the club in the male; three-fourths the length of the club in the female; not three-fourths and one, respectively. Male further separable from *h. hamifer* and *h. vicens* in having three long bristles on the eighth sternum, not four or two, respectively. Otherwise very similar to other subspecies of *hamifer* except as follows:

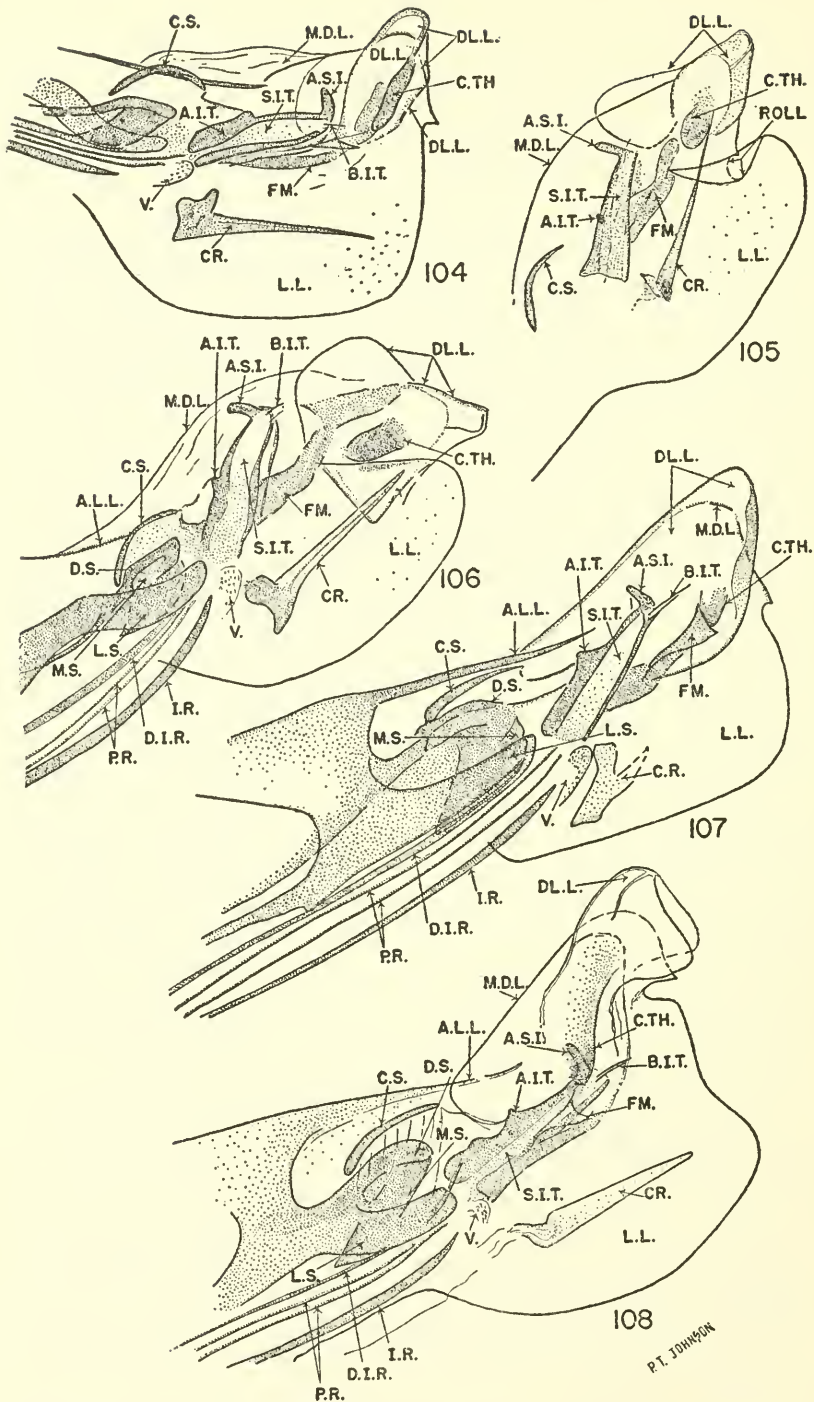
Head (fig. 124).—Bristles on second antennal segment one-half length of club in male, three-fourths length of club in female.

Male.—Eighth sternum (fig. 129) with apex squared; row of three long bristles present on upper half, set well in from margin; one small bristle below and in line with this row; plus three small apical bristles on upper half of posterior margin. As in other subspecies, characteristic bristle on posterior margin of process (fig. 131, *P.*) set well above middle of margin. Movable finger (*F.*) definitely wedge-shaped, dorsal margin straight; anteroapical and posteroapical angles similar; posterior margin almost straight; anterior margin gently concave. Distal arm of ninth sternum (fig. 128) much as in *h. hamifer*, with four large bristles at middle of ventral (posterior) margin; laterally with small scattered bristles on sclerotized portion.

Aedeagus (fig. 126).—As in the other subspecies, except spiculation on lateral lobes (*L.L.*) confined to a very small area well above level of insertion of crochets (*CR.*), and lacking striations below.

Female.—Lobe on posterior margin of seventh sternum triangulate in holotype (fig. 127, *7S.*); somewhat longer and narrower in paratypes (fig. 130). Anal stylet and spermatheca (fig. 125) as in other subspecies.

Length.—Holotype, 2.0 mm.; allotype female, 2.5 mm.; paratype females 2.7-2.8 mm.



FIGS. 104-108.—Aedeagus of *Peromyscopsylla hesperomys hesperomys*, *P. scotti*, and *P. draco*: 104, *P. h. hesperomys*, with distolateral lobes in normal position; 105, same, with distolateral lobes depressed; 106, same; 107, *P. scotti*; 108, *P. draco*. For explanation of symbols see pages 67-68.

PEROMYSCOPSYLLA OSTSIBIRICA OSTSIBIRICA (Skalon, 1936)

FIGURES 122, 123

Leptopsylla ostsibirica SKALON, Izvest. Gosudarstv. Inst. Siberia i DVK, vol. 4, pp. 48, 52, 55, 1936; Materialy K. Poznaniiu Fauny i Flory S.S.S.R., n. s., Zool., No. 15 (XXX), Ectoparasites, II, pp. 74–84, 1950, Moscow.

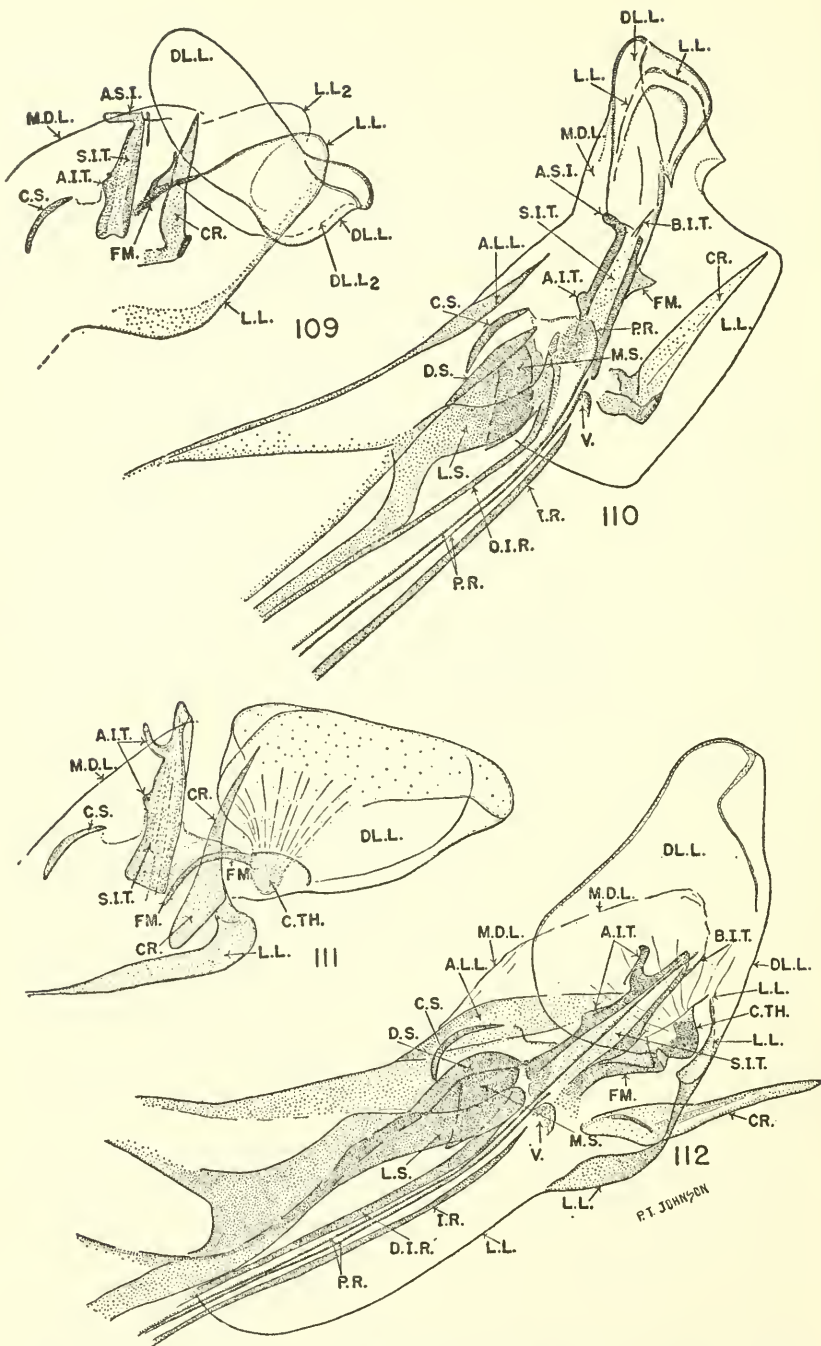
A translation of Skalon's 1950 description and the type distribution is as follows:

Female and male. This species is closely related to the European species *L. bidentata* K. and the North American *L. hamifer* R. Prefrontal row consists of nine to eleven bristles arranged all along the length of frons. The fourth and fifth of these (from above) are much thickened; the sixth is less modified and seems intermediate between the preceding bristles and those that follow, which are fairly long and of the usual shape. Head ctenidium consists of two teeth, pronotal ctenidium of 25–28 teeth. Abdominal tergites from the first to the sixth inclusive have many chitinous apical teeth; the number varies greatly, but the average is 5,6,5,3,3,2. Male has three antepygidial bristles (in one case three bristles were found on one side and two on the other); female has five to seven. All the antepygidial bristles are set in one row, long ones alternating with short ones. Lateral surfaces of posterior femora have at the base one bristle on the outer side and one or two on the inner, at the apex two or three on outer side and one on inner.

Male. Apical lobe of eighth sternite (fig. 5) [our fig. 122, 8S.] has its posterior margin cut away in a straight line, and its ventral angle projects sharply downward; along posterior margin there are three long bristles and three smaller ones. Base of apical lobe has one strong ventral bristle on each side. Immobile finger [P.] is long and wide, with rounded apex; its posterior margin has conspicuous bristle below the first third. Movable finger [F.] is regular and triangular in shape; three large bristles are placed at the apical angle, which is almost a right angle. There are some small bristles on the upper margin, which is almost straight, and the posterior margin, which is slightly concave. Manubrium of clasper is wide in basal half and narrows unevenly farther on. Distal part of horizontal branch of ninth sternite [D.A.9] has its ventral and dorsal margins almost parallel; ventral margin has many small bristles on its basal third and three strong bristles at almost the same distance farther on; apex is obliquely cut away, with angle projecting upward and margin set with small bristles.

Female. Apical margin of seventh sternite of female (fig. 6) [our fig. 123] has a deep lateral indentation dividing the wide rounded ventral lobe from the dorsal, which projects over this indentation and looks like a long, straight beak. Lateral surface of sternite has a regular row of seven to nine large bristles and one to three small ones.

Length 2.3–3 mm. We found a series of specimens of this species, six female and five male, around the Alexandrov plant (eastern Transbaikal). The species is adapted to parts of the forest, and was found on *Evotomys rutilus* and *rufocanus*, or *Microtus unguirensis* and *mongolicus*. Also it has been found in considerable numbers around Kabansk (eastern Baikal) in forest steppe country on *Evotomys rutilus* and *rufocanus*, *Microtus michnoi* and *unguirensis*, and



FIGS. 109-112.—Aedeagus of *Peromyscopsylla ebrighi* and *P. catatina* showing distolateral lobes depressed and in normal position: 109, *P. ebrighi*, lobes depressed; 110, same, with lobes in normal position; 111, *P. catatina*, lobes depressed; 112, same, with lobes in normal position. For explanation of symbols see pages 67-68.

Micromys minutus, by L. V. Fedorova. Around Khabarovsk it has been collected by N. L. Gershkovich.

As can be seen from our copies of Skalon's 1950 figures and the above description, *ostsibirica* is very close to *P. longiloba* (Jordan, 1939). In fact, *longiloba* is considered below as a subspecies of *ostsibirica* (Skalon, 1936). Since specimens of *ostsibirica ostsibirica* are not available for study, a more complete comparison of *hamifer* ssp. and *ostsibirica* ssp. is given in the discussion of *ostsibirica longiloba* (Jordan, 1939), new combination.

The male differs from *ostsibirica longiloba* in that the eighth sternum (fig. 122, ♂S.) is not apically subrectangular; the posterior margin being obviously oblique and the ventral margin evenly concave; not with this segment apically subrectangular, with the posterior margin almost vertical and the ventral margin almost straight (fig. 85). Other details of the modified segments are apparently the same as in *o. longiloba*. The female is apparently indistinguishable from *o. longiloba* (compare figs. 123 and 84).

**PEROMYSCOPSYLLA OSTSIBIRICA LONGILOBA (Jordan, 1939),
new status**

FIGURES 83-86, 119

Leptopsylla hamifer longiloba JORDAN, Nov. Zool., vol. 41, p. 319, fig. 270, 1939.
Peromyscopsylla hamifer longiloba HUBBARD, Fleas of western North America, pp. 336, 337, fig. 205, 1947.

Head.—As in *hamifer*, except apical bristles on second antennal segment one-half length of club in male, three-fourths length of club in female (not three-fourths and one-fourth, respectively).

Thorax and *abdomen* as in *hamifer* except: female with five to seven antepygidial bristles (of two females examined, one had seven on both sides, the other had six on one, seven on other; the original description states that the holotype had seven bristles on each side, the paratype five on each side).

Male.—Differing from *hamifer* in the following points: movable finger or digitoid of clasper (fig. 86, F.) roughly forming an isosceles triangle, with obtuse angle at middle of posterior border. Eighth sternum (fig. 85) definitely rectangular; dorsal and ventral borders parallel; bearing marginally five to six bristles, three of these set on mesal surface and quite long, other two or three medium-sized, set on margin itself; one medium-sized bristle may be present anterior to lowest long bristle; several very minute hairs in posteroventral corner; membranous process (*M.P.*) large, spiculated. Distal arm of

ninth sternum (fig. 83) with a few short apical bristles (as in *bidentatus*); posterior margin with three widely spaced marginal bristles, these quite long; patch of basal marginal bristles; laterally with quite small scattered bristles, all restricted to sclerotized portion.

Aedeagus (fig. 119).—Much as in *hamifer*. Armature of inner tube reduced, inapparent. Crochets (*CR.*) much longer than in *hamifer*, longer than *S.I.T.* Microverrucae or spicules limited to a small subdorsal margin of lateral lobes; the spicules definitely longer than in *hamifer*. (*M.D.L.* not visible in only specimen studied, and hence deleted from figure.)

Female.—Posterior margin of seventh sternum (fig. 84) with long, narrow, subacute lobe followed ventrally by deep, rounded sinus; ventral lobe broader, not extending quite as far posteriorly as dorsal lobe. Anal stylet about $4\frac{1}{2}$ times as long as broad, bearing one long apical bristle and two shorter ventromarginal bristles.

Holotype.—Female, from *Microtus*, 1-mile camp, Valdez Creek Trail, Alaska.

The range of *ostsibirica longiloba* is probably Alaska and northwestern Canada.

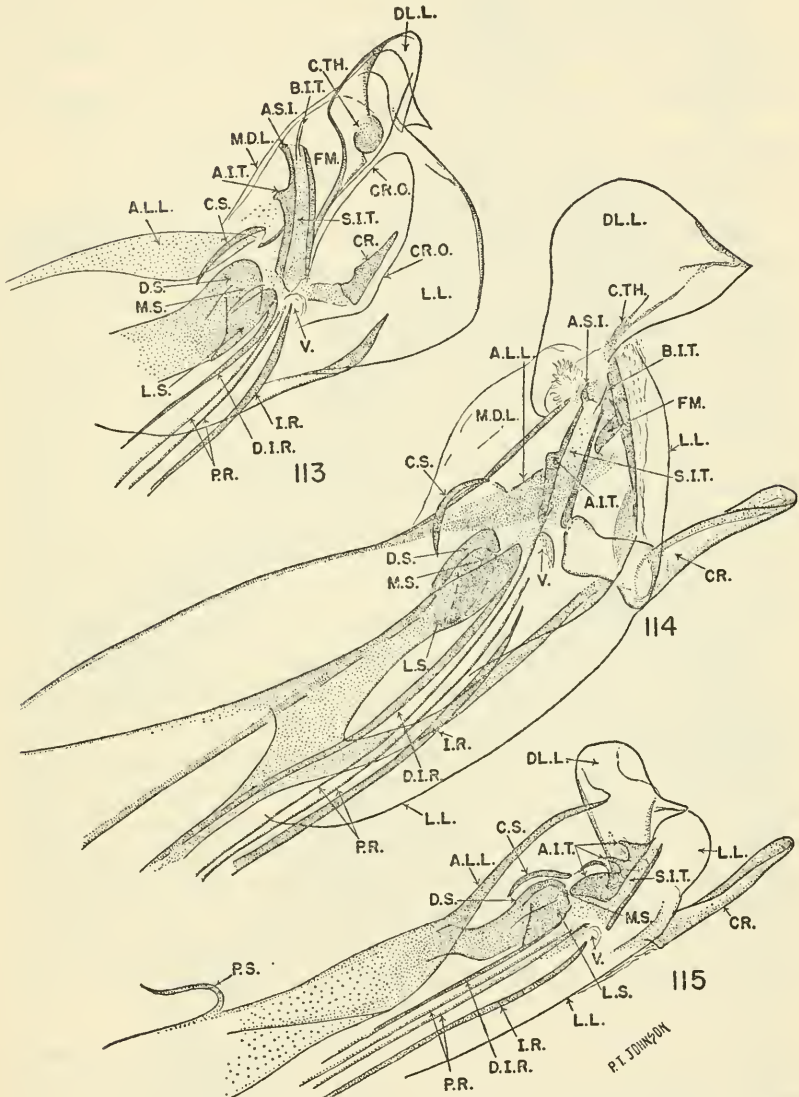
RECORDS OF SPECIMENS EXAMINED

From Anchorage, Alaska: One male and two females from *Microtus* sp., Aug. 10, 1950. One male from *Clethrionomys* sp., no date given, R. Rausch.

PEROMYSCOPSYLLA BIDENTATA (Kolenati, 1863)

FIGURES 87-90, 120

- Ctenopsyllus bidentatus* KOLENATI, Hor. Soc. Ent. Rossicae, vol. 2, p. 38, pl. 3, fig. 9, 1863.
- Ctenopsylla* (*Ctenopsyllus*) *bidentata* WAGNER, Hor. Soc. Ent. Rossicae, vol. 27, p. 351, 1893.
- Ctenopsyllus bidentatus* ROTHSCHILD, Ent. Month. Mag., vol. 45, p. 185, 1909.
- Ctenopsyllus sobrinus* ROTHSCHILD, Ent. Month. Mag., vol. 45, p. 186, p. 2, fig. 3, 1909; Nov. Zool., vol. 16, p. 332, 1909.
- Ctenopsyllus bidentatus* ROTHSCHILD, Ann. Sci. Nat., Paris, zool. ser. 9, vol. 12, p. 215, 1911.
- Ctenopsyllus monoctenus* KOLENATI, in Rothschild, Nov. Zool., vol. 18, p. 56, 1911 (sinks *bidentatus* and *sobrinus*).
- Ctenopsyllus sobrinus* DAMPF, Schr. Phys.-ökon. Ges. Königsberg, vol. 52, p. 277, 1912 (claims *monoctenus* not available because not binary).
- Ctenopsyllus bidentatus* JORDAN and ROTHSCHILD, Ectoparasites, vol. 1, p. 62, 1920 (state *monoctenus* Kolenati, 1856, is new name for *sciuri* of authors).
- Leptopsylla bidentatus* JORDAN and ROTHSCHILD, Ectoparasites, vol. 1, p. 113, fig. 101, 1920.



FIGS. 113-115.—Aedeagus of *Peromyscopsylla silvatica silvatica* (fig. 113), *P. selenis* (fig. 114), and *P. himalaica* (fig. 115). For explanation of symbols see pages 67-68.

Ctenopsylla bidentata WAGNER, Akad. Nauk S.S.S.R. Zool. Inst., Parazitol. Sbornik (Mag. Parasitol. Mus. Zool. Acad. Sci.), Leningrad, vol. 1, p. 148, pl. 13, fig. 94, 1930.

Leptopsylla bidentatus JORDAN, Nov. Zool., vol. 36, p. 230, 1931; vol. 38, p. 257, 1932.

Ctenopsyllus bidentatus WAGNER, Tierwelt Mitteleuropas, vol. 6, Abt. 17, p. 16, 1936.

Peromyscopsylla bidentatus HOPKINS and ROTHSCCHILD, in MS.

Head, thorax, and abdomen.—As in *hamifer*.

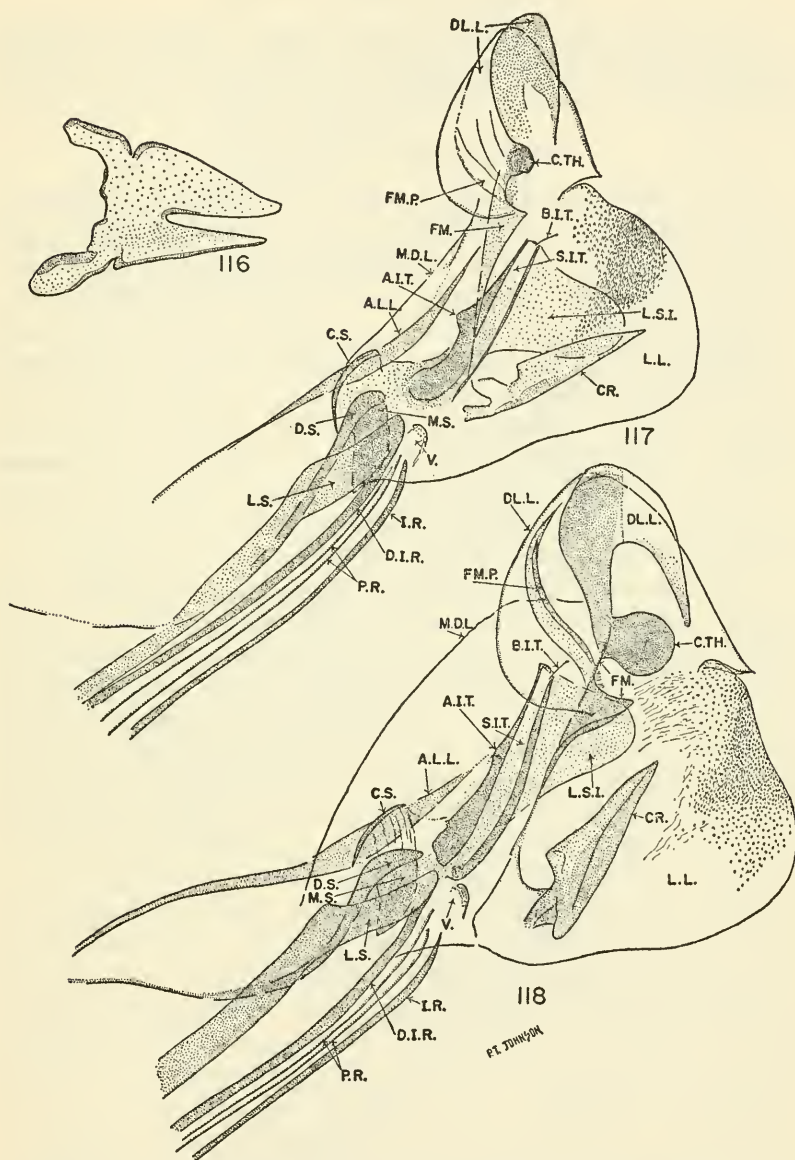
Male.—As *h. hamifer* except in the following points: manubrium very narrow, acuminate; immovable process of clasper (fig. 87, *P.*) with very narrowly rounded apex; triangular in shape, with dorsal and posterior margins forming longest sides of triangle; characteristic bristle on posterior margin a little longer than greatest width of movable finger, set well above midpoint. Movable finger or digitoid of clasper (*F.*) elongate and narrow, gradually broadening from near base to apex; crescentic, five times as long as wide at maxima; posterior margin with three long bristles, two of these near apex, third considerably lower, but above midpoint; anteromarginal bristles shorter than is usual in the genus. The four long bristles of sternum 8 (fig. 89) as in *h. hamifer*. Distal arm of ninth sternum (fig. 90) much as in *h. hamifer* but with clump of short, stout apical bristles.

Aedeagus (fig. 120).—Of the *hamifer* type with respect to the keel-like lateral sclerotization of inner tube (*L.S.I.*); the spicules or microverrucae on the lateral lobes (*L.L.*); the huge size of the end chamber and of the distolateral lobes (*DLL.*); and the distolateral lobes being subdivided into two portions, a relatively weakly sclerotized portion and a more apical, lateral, more heavily sclerotized region. Crochets (*CR.*) short, broad at base and resembling a somewhat twisted triangle. Microverrucae or spicules on lateral lobes large and scalelike; limited to a band at apex of crochet. Apicolateral portion of *DLL.* larger than unspecialized proximal portion. Lateral sclerotization of inner tube (*L.S.I.*) prominent but scarcely broader than *S.I.T.* Apex of sclerotized inner tube (*A.S.I.*) not expanded.

Female.—Spermatheca (fig. 88, *SP.*) as in *hesperomys*. Seventh sternum (fig. 88) with long, narrow lobe followed ventrally by deep, evenly rounded sinus. No row of bristles on eighth tergum, above spiracle. Anal stylet about four times as long as broad; bearing one long apical and two shorter subapical bristles.

Type.—From *Sciurus vulgaris*.

The range of *bidentata* is Europe, and apparently western Asia to Siberia.



FIGS. 116-118.—*Peromyscopsylla hamifer hamifer* and *P. h. vigenis*: 116, Crochet, dorsal view, *P. h. hamifer*; 117, aedeagus, *P. h. hamifer*; 118, same, *P. h. vigenis*. For explanation of symbols see pages 67-68.

RECORDS OF SPECIMENS EXAMINED

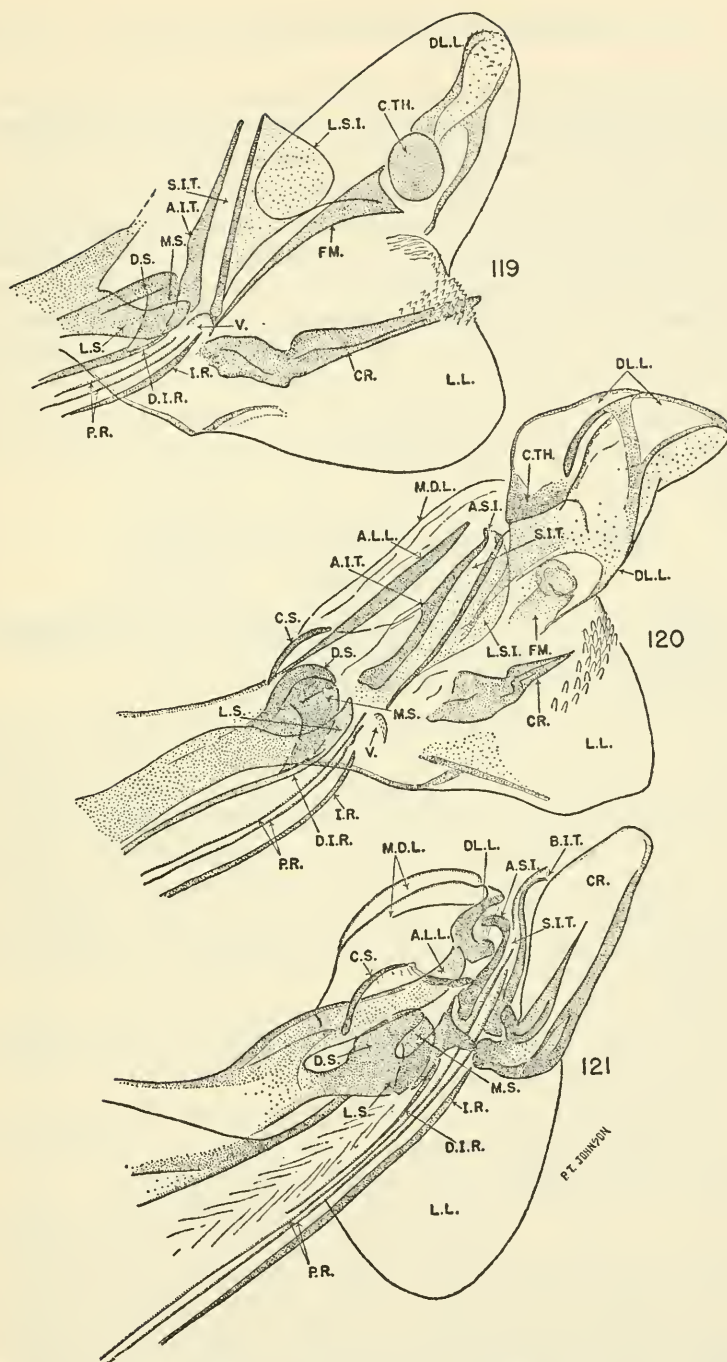
One male from *Eliomys quercinus*, Upper Bavaria, Waldmünchen, Germany, Aug. 25, 1948, Gerd Heinrich. One female from *Clethrionomys* (= *Evotomys*) *glareolus helveticus* Zermatt, Switzerland, Sept. 18, 1917, K. Jordan and N. C. Rothschild.

DISCUSSION OF THE *hamifer* GROUP

The *hamifer* group of *Peromyscopsylla* is here defined as that group of *Peromyscopsylla* in which the genal process is concealed by the upper genal spine, the upper genal spine is the longer, there are normally three subdorsal bristles between the spiniform bristles and antennal margin on the dorsal margin of the head and four regular rows of bristles on the postantennal area of the head. Aedeagal similarities are discussed in the section below. Included in this group are *P. hamifer* ssp. (from eastern and western United States, Canada, and Korea), *ostsibirica* ssp. (from Alaska and Siberia), and *bidentata* (from Europe). *P. hamifer* has been arbitrarily selected as "parent species" of this group purely for the sake of convenience and not with the belief that it is necessarily such in the evolution of the group.

P. bidentata, the only described European form belonging to this group, is quite distinct from *hamifer* in both male and female. In the female the differences may seem of rather unimportant proportions, i.e., merely differences based upon the shape of the seventh sternum, but it should be remembered that *hamifer hamifer* and *hamifer vigenis* females are morphologically indistinguishable, although the males of these two subspecies may be determined readily (see descriptions and figures of *h. hamifer* and *h. vigenis*). *P. ostsibirica* ssp. from Alaska and Siberia differs from both *hamifer* ssp. and *bidentata* but is undoubtedly more closely related morphologically to *hamifer* than to *bidentata*. Again, the females of *o. longiloba* differ from *hamifer* ssp. in like degree as *hamifer* differs from *bidentata*, but also differ from *bidentata* in that the apical bristles on the second antennal segment are three-fourths the length of the club in the female, not reaching the apex of the club; and one-half length of club, not three-fourths length, in male. This nonsexual character in this case, considered with other characters, is believed to be of higher than subspecific level. It is expected that *o. ostsibirica* from Siberia will show the same variation.

Owing to its probably longer isolation, *P. bidentata* is regarded at present as being most distinct from the "parent species," *hamifer*. *P. ostsibirica* ssp., on the other hand, may not have been separate for so long a time and hence is more similar to *hamifer*. The subspecies of *hamifer* itself are probably on the way to forming separate species, but



FIGS. 119-121.—Aedeagus of *Peromyscopsylla longiloba* (fig. 119), *P. bidentata* (fig. 120), and *P. tikhomirovae* (fig. 121). For explanation of symbols see pages 67-68.

their morphological similarity in the female and relatively great similarity in the male (as compared to the other species in the group) indicate a probable relationship at the subspecific level.

As further indication of the above, the aedeagus of each of the species of the *hamifer* group shows differences believed to be at the species level, considering the fact that equal variation, or even less, is found among the other full species of the genus (i.e., *draco*, *ebrighti*, and *hesperomys*). The aedeagus is similar in the various subspecies of *P. hesperomys*, and the same is true for the subspecies of *P. silvatica*. However, *P. hamifer hamifer*, *P. hamifer vigens*, and *P. hamifer cuneata* ssp. nov. differ from one another insofar as amount and placement of spiculation on the lateral lobes are concerned. (See figs. 117, 118, and 126, *L.L.*)

PEROMYSCOPSYLLA TIKHOMIROVAE (Ioff, 1946)

FIGURES 91-98, 121

Leptopsylla tikhomirovae IOFF, in Ioff, Tiflov, et al., *Meditinskafā parazitologiā i parazitarnye bolezni*, Moscow, vol. 15, No. 4, p. 91, 1946.

Peromyscopsylla tikhomirovae HOPKINS and ROTHSCILD, in MS.

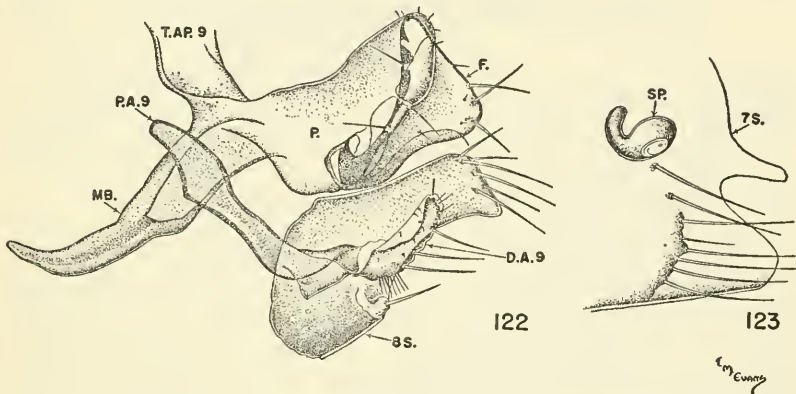
Head (fig. 91).—Not as bullet-shaped as in other members of the genus. No spiniforms on preantennal area; with four anteromarginal bristles and a row of three subdorsal bristles commencing at frontal angle; in addition, five nonmarginal bristles (three missing in specimen drawn). Spines of genal ctenidium more slender than is usual in genus, upper genal spine the longer, obscuring genal process; genal lobe apparently undeveloped. Second antennal segment with bristles reaching end of club in both sexes. Postantennal area with three rows of bristles.

Thorax.—As in *hesperomys*, except bristles relatively fewer on mesonotum (fig. 92); few bristles present anterior to four complete rows, and no erect bristles dorsally.

Abdomen.—Anterior row of bristles present only on terga 1 and 2 in male, this row represented by one or two lateral bristles in female. Male and female with three antepygial bristles.

Male (fig. 94).—Tergum 8 (*8T.*) with row of three large bristles posterior to spiracle. Eighth sternum (*8S.* and fig. 97) peculiar, apically long and narrow, and upcurved (reminiscent of ninth sternum of some rhopalopsyllids); apical half of extension with a ventromarginal row of fairly long bristles plus four or five small mesal bristles; with two large subventral bristles proximad to elongate portion; membranous process not visible (this area in only available speci-

men very granular). Immovable process of clasper (*P.* and fig. 96) truncate, dorsal and ventral margins subparallel; lacking characteristic bristle; at insertion of movable finger on posterior margin about five small apical and subapical bristles. Digitoid or movable finger of clasper (*F.*) $1\frac{1}{2}$ times as long as broad; convex posterior margin with three long bristles above and two below middle. Distal arm of ninth sternum (*D.A.9* and fig. 98) poorly sclerotized; with apical portion narrowed, subtruncate; posterior (ventral) portion with a fringe of many rather long bristles.



FIGS. 122-123.—*Peromyscopsylla ostsibirica*: 122, Clasper, eighth and ninth sternum, ♂ (from Skalon, 1950); 123, spermatheca and seventh sternum, ♀ (from Skalon, 1950). For explanation of symbols see pages 67-68.

Aedeagus (figs. 94 and 121).—Lateral lobes (*L.L.*) very broad, so that end chamber is more than twice as broad as long. Median dorsal lobe (*M.D.L.*) well sclerotized, becoming bifid above crescent sclerite (*C.S.*). Distolateral lobes (*D.L.L.*) represented only as a small indistinct sclerite lying above sclerotized inner tube (*S.I.T.*). Apex of sclerotized inner tube (*A.S.I.*) conspicuously turned dorsad. Band of inner tube (*B.I.T.*) relatively well developed. Armature of inner tube not developed. Crochets (*CR.*) very conspicuous, about $2\frac{1}{2}$ times as long as broad; subovate or slipper-shaped; with a median acuminate lateral thickening which apparently is all that remains of the crochet in many other species of *Peromyscopsylla*.

The aedeagus of *P. tikhomirovae* is apparently primitive in several respects: the large crochet which is fairly well sclerotized; the bifid median dorsal lobes; the small inconspicuous distolateral lobes; the absence of the fulcrum; and the lack of armature on the inner tube.

Female (fig. 95).—Sternum seven (*7.S.*) with slightly undulate posterior margin. Anal stylet (*A.S.* and fig. 93) $1\frac{1}{3}$ times as long as

broad; with two long apical bristles, dorsal much longer than ventral. Spermatheca (*SP.*) with tail as long as body and about one-third as wide.

Types.—From *Calomyscus bailwardi*, Kopet Dagh [Range].

The range is probably northeastern Asia.

RECORDS OF SPECIMENS EXAMINED

One male and one female from *Calomyscus bailwardi*, Firusa, Turkmenia, 1946.

PEROMYSCOPSYLLA HIMALAICA (Rothschild, 1915)

FIGURES 99-103, 115

Leptopsylla himalaica ROTHSCHILD, Nov. Zool., vol. 22, p. 305, figs. 5, 6, 1915.

Ctenopsylla himalaica WAGNER, Akad. Nauk S.S.S.R. Zool. Inst., Parazitol. Sbornik (Mag. Parasitol. Mus. Zool. Acad. Sci.), Leningrad, vol. 1, p. 146, pl. 13, figs. 88, 89, 1930.

Peromyscopsylla himalaica HOPKINS and ROTHSCHILD, in MS.

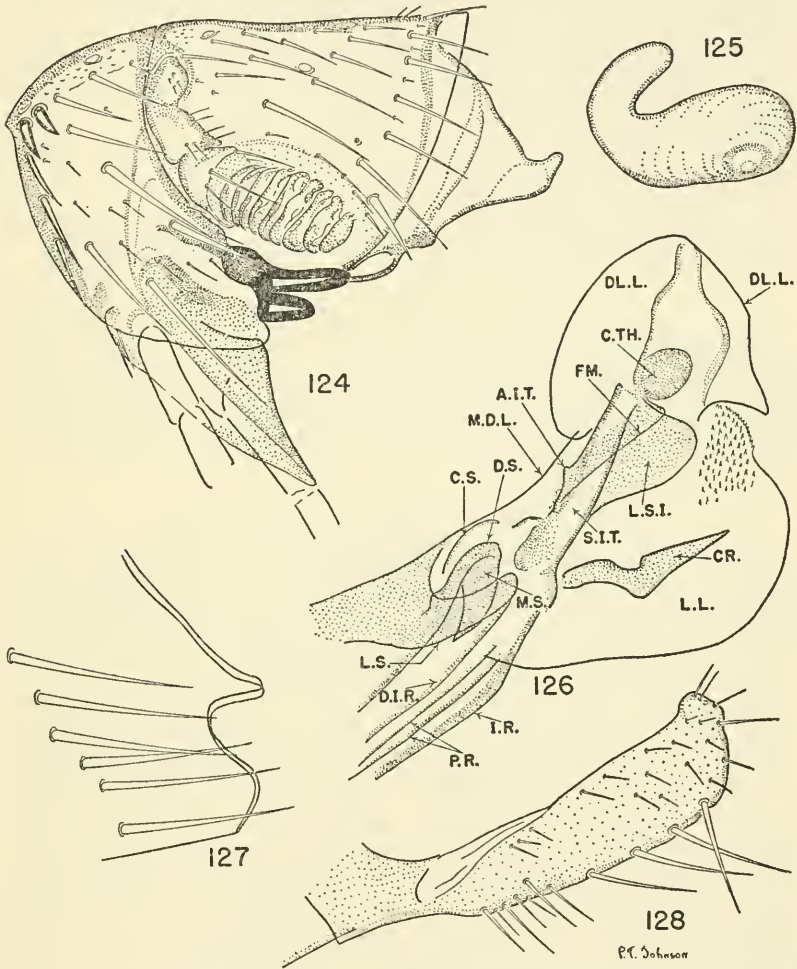
Head.—Similar to *tikhomirovae* but with six bristles other than marginals on preantennal area (five in female); genal spines broader than in *tikhomirovae*. Second antennal segment apparently with extremely short bristles in both sexes (difficult to see in only male examined). Postantennal area with four or five irregular rows of bristles.

Thorax.—As in *hesperomys*, except no erect dorsal bristles on the mesonotum.

Abdomen.—Male with three antepygial bristles; female also with three, but unique in that ventralmost separated from others by a gap, and possessing its own pedestal (fig. 102).

Male.—Membranous collar of sensilial segment very large, overlapping one-half of dorsal anal lobe. Portion of eighth tergum posterior to spiracle with three long thin bristles and one smaller bristle anterior to these. Sternum 8 (fig. 99) conical, bearing three light, thin apical bristles; about five to six subapical bristles, three of these very long; proximally with two bristles, one long; membranous process (*M.P.*) arising from proximodorsal portion. The long characteristic bristle on posterior margin of immovable process of clasper (fig. 101, *P.*) absent. Movable finger or digitoid of clasper (*F.*) narrow, about $3\frac{1}{2}$ times as long as broad, approximately the same width from base to apex. Distal arm of ninth sternum (fig. 103) semimembranous on dorsal (anterior) margin; posterior (ventral) margin rounded and bearing four or five bristles plus several much smaller ones distad to these; acuminate apex with group of very short bristles.

Aedeagus (fig. 115).—Unique in possessing a proximal spur (*P.S.*). Distolateral lobe (*DL.L.*) relatively small; broader (higher) than long; central thickening (*C.TH.*) unapparent. Sclerotized inner



FIGS. 124-128.—*Peromyscopsylla hamifer cuneata*, new species: 124, Head, holotype, ♂; 125, spermatheca, allotype, ♀; 126, apex of aedeagus, holotype, ♂; 127, seventh sternum, allotype, ♀; 128, distal arm of ninth sternum, holotype, ♂. For explanation of symbols see pages 67-68.

tube (*S.I.T.*) lacking ventral armature as well as sclerotized band of inner tube. Armature of inner tube (*A.I.T.*) well developed, consisting of three dorsal thickenings or spurs, one of these subapical. Crochets (*CR.*) long and narrow, spatulate. Median dorsal lobe

apparently very weakly sclerotized; unapparent in single specimen examined.

Female.—Spermatheca (fig. 100, *SP.*) with more heavily sclerotized body than is usual in genus and insertion of tail more definitely delineated. Posterior margin of seventh sternum (fig. 100) with elongate upper lobe; oblique below this to rounded posteroventral lobe. Anal stylet $3\frac{1}{2}$ times as long as broad with one apical and one subapical bristle.

Types.—From *Rattus norvegicus* (= *Epimys decumanus*), Simla, northwest India.

The range of this species is probably the Himalayas, including northern India, southwestern China, and northeastern Burma.

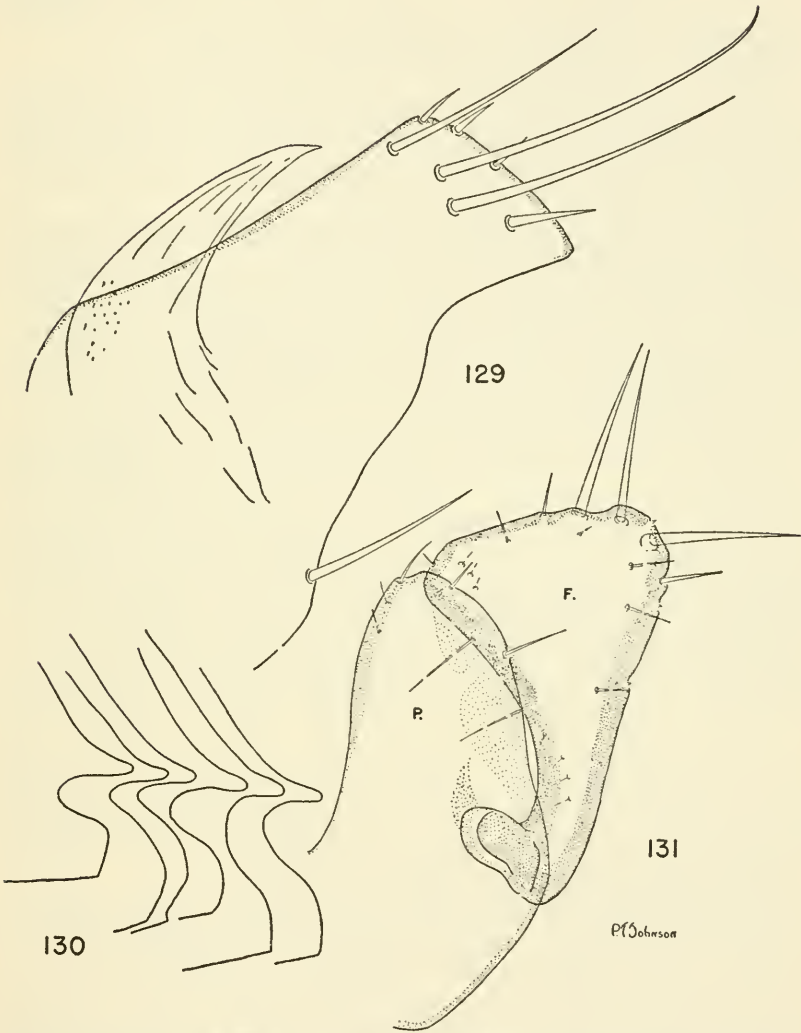
RECORDS OF SPECIMENS EXAMINED

One male from *Rattus norvegicus* (= *Epimys decumanus*), northwest Himalayas, Aug. 8, 1912. One female from *Vandeleuria oleracea nilagirica*, Kodai-kanal, Palni Hills, south India, elevation 7,000 ft., 1929, B. Fletcher. One female from *Rattus confucianus*, Kunming, Yunnan Province, China, Aug. 10, 1945, U. S. Typhus Commission.

DISCUSSION OF THE AEDEAGUS OF *Peromyscopsylla*

A comparative study of the morphology of the aedeagus of the species of *Peromyscopsylla* not only enables one to homologize the various sclerites involved, but also to name and understand structures that at first glance seem unique or unrecognizable.

The most characteristic feature of the aedeagus of this genus is the pair of distolateral lobes (fig. 104, *DL.L.*). No comparable structure exists in the genera whose aedeagi have been studied thus far, although the related genus *Paractenopsyllus* Wagner, 1938, is similarly modified. The distolateral lobes are undeveloped in *Peromyscopsylla tikhomirovae* Ioff, 1946, where they resemble the apicomedian sclerite of many other genera. In the other *Peromyscopsylla*, the distolateral lobes are much more conspicuous, and extend apicad to the sclerotized inner tube (*S.I.T.*). They are freely movable flaps, and are articulated with the sclerotized inner tube via the fulcrum (*FM.*), and apparently also are connected with the crochets (*CR.*), because *S.I.T.* and the crochets are usually parallel. When *DL.L.* is inclined ventrad, then *S.I.T.* and *CR.* are both subvertical in position, instead of being subhorizontal as normally. The various positions assumed make a study of the aedeagus difficult until it is appreciated that these structures are flaps which not only affect the inclination of *S.I.T.* and *CR.*, but also that of the lateral lobes (*L.L.*). The dorsoapical margins of



FIGS. 129-131.—*Peromyscopsylla hamifer cuneata*, new species: 129, Eighth sternum, holotype, ♂; 130, seventh sternum variations, paratype, ♀♀; 131, clasper, holotype, ♂. For explanation of symbols see pages 67-68.

L.L. are apparent only when the distolateral lobes are inclined ventrad (figs. 105, 106); at such times the rolled connecting portions may be visible (fig. 105, *ROLL*). The various relative positions of these structures are illustrated for *P. hesperomys* (figs. 104–106), *P. catatina* (figs. 111, 112), and *P. ebrighti* (figs. 109, 110).

The distolateral lobes reach their maximum development in the subspecies of *P. hamifer* and *P. ostsibirica longiloba*. There the structures are not only relatively enormous in size, but are modified so as to possess a heavily sclerotized, more lateral, horseshoe-shaped portion bearing the central thickening (*C.TH.*).

P. tikhomirovae, in addition to having very small distolateral lobes and large unmodified lateral lobes (fig. 121, *L.L.*), is also unspecialized in that the crochets are of the type characteristic of the *Leptopsyllinae* in general—very large structures longer than the end chamber—here three times as long as broad and apically subrounded, with a median lateral acuminate rib (*CR.*). In *P. silvatica* the crochet is of a similar shape (fig. 113, *CR.*) but only a sagittate or acuminate sclerotization is readily visible, the crochet outlines (*CR.O.*) being semi-membranous. The sagittate rudiment is probably the homologue of the median lateral rib of *tikhomirovae*. In the other *Peromyscopsylla* the crochet is even more reduced—the crochet outlines, too, are unapparent. In *P. selenis* (fig. 114, *CR.*) only the crochet base and ventral portion are sclerotized. *P. himalaica* (fig. 115) shows further reduction in that much of the base is semimembranous. The rib remnant or crochet vestige is somewhat dagger-shaped in *P. hesperomys* (fig. 104), *ebrighti* (fig. 110), *draco* (fig. 108), and *catatina* (fig. 112); but subsagittate³ in *hamifer* (figs. 117, 118), *ostsibirica longiloba* (fig. 119), and *bidentata* (fig. 120). The crochets of *P. selenis* (fig. 114) and *himalaica* (fig. 115) are apically somewhat spatulate. Reduction has proceeded even farther in *scotti* (fig. 107), where only a portion of the base of the crochet remains.

The lateral lobes are well developed but relatively unspecialized in *P. tikhomirovae* (fig. 121, *L.L.*), *scotti* (fig. 107), *ebrighti* (fig. 110), *silvatica* (fig. 113), and *draco* (fig. 108). In *P. hamifer* (fig. 117), *ostsibirica longiloba* (fig. 119), and *bidentata* (fig. 120), not only are the lateral lobes even relatively larger but they are adorned with definite characteristic spiculate or rugose processes. *P. hesperomys* (fig. 104), however, is minutely spiculate.

The lateral lobes are somewhat reduced in *P. selenis* (fig. 114), *catatina* (fig. 112), and *himalaica* (fig. 115). It is of interest and

³ As seen in the mounted specimen, i.e., lateral aspect. The dorsal view (slightly askew) is illustrated in figure 116.

probably phylogenetic significance to note that in an occasional specimen of *P. hesperomys* the lateral lobe bears a minute but unmistakable bristle.

In *Peromyscopsylla*, the armature of the sclerotized inner tube (*A.I.T.*) is represented as a rule by a median dorsal spur or thickening, as in *P. hesperomys* (fig. 104), *hamifer* (fig. 117), *ostsibirica longiloba* (fig. 119), *bidentata* (fig. 120), *draco* (fig. 108), *silvatica* (fig. 113), *scotti* (fig. 107), and *selenis* (fig. 114). This spur is not developed in *P. tikhomirovae* (fig. 121). However in *P. himalaica* (fig. 115), the dorsal armature is basally expanded and also includes a median and a long subapical spur. *P. catatina* (fig. 112) likewise possesses a conspicuous subapical *A.I.T.* The lateral armature of the sclerotized inner tube (*L.S.I.*) is undeveloped, except in *P. hamifer* (fig. 117), *ostsibirica longiloba* (fig. 119), and *bidentata* (fig. 120), where it is produced into a stout keel, especially in the first two.

The dorsal margin of the apex of the sclerotized inner tube (*A.S.I.*) is upturned in *P. hesperomys* (fig. 104), *tikhomirovae* (fig. 121), *scotti* (fig. 107), and *ebrighti* (fig. 110).

P. himalaica seems unique in the possession of a well-developed proximal spur (fig. 115, *P.S.*).

The aedeagus of the *hamifer* group (*P. h. hamifer*, *h. cuneata* ssp. nov., *h. vicens*, *ostsibirica longiloba*, and *bidentata*) is characterized by a keellike *L.S.I.*, large spicules or microverrucae, a huge end chamber, and very large distolateral lobes which are subdivided into two portions.

EXPLANATION OF SYMBOLS ON FIGURES

A.A.R.	accessory apodemal rod	C.S.	crescent sclerite of aedeagus
A.B.	antepygial bristles	C.TH.	central thickening of distolateral lobe of aedeagus
A.E.A.	aedeagal apodeme	D.A.L.	dorsal anal lobe of proctiger
A.I.T.	armature of inner tube	D.A.9	distal arm of ninth sternum
A.L.L.	accessory lateral lobe of aedeagus or extension of lateral plate of aedeagal apodeme	D.I.R.	dorsal intramural rod of aedeagus
AP.A.	apical appendage of aedeagal apodeme	DL.L.	distolateral lobe of aedeagus
A.S.	anal stylet	D.O.	ductus obturatus
A.S.I.	apex of sclerotized inner tube	D.S.	dorsal sclerite of apodemal strut
A.T.A.	anterior tentorial arm	8S.	eighth sternum
B.C.	bursa copulatrix	8T.	eighth tergum
B.I.T.	band of inner tube	F.	movable finger or digitoid of clasper
CR.	crochet	FM.	fulcrum of distolateral lobe of aedeagus
CR.O.	crochet outline		

FM.P.	fulcrum process of distolateral lobe	MSN.	mesonotum
		MTM.	metepimere
G.L.	genal lobe	MTN.	metanotum
G.P.	genal process	MTS.	metepisternum
I.R.	intramural rod of aedeagus	P.	immovable process of clasper
L.L.	lateral lobe of aedeagus	P.A.9	proximal arm of ninth sternum
L.M.	lateral metanotal area		
L.S.	lateral sclerite of apodemal strut	PL.A.	pleural arch of metathorax
		P.R.	penis rod
L.S.I.	lateral sclerite of inner tube	P.S.	proximal spur of aedeagus
MB.	manubrium	PS.S.	pseudosetae
MB.C.	membranous collar of sensillial segment of male	7S.	seventh sternum
		7T.	seventh tergum
M.D.L.	median dorsal lobe of aedeagus	SP.D.	spermathecal duct
		S.I.T.	sclerotized inner tube of aedeagus
M.P.	membranous process of eighth sternum	SN.	sensillum
MPM.	mesepimere	SP.	spermatheca
MPS.	mesepisternum	T.AP.9	tergal apodeme of segment nine
M.S.	median sclerite of apodemal strut	V.	vesicle of aedeagus

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